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STANDARD ENGINE REPORT OF AEROMARINE MODEL U-8-D AVIATION ENGINE RATED AT 180 HORSE-POWER AT 1,750 REVOLUTIONS PER MINUTE

(POWER PLANT SECTION REPORT)

Prepared by Engineering Division, Air Service
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INDEX.

STANDARD ENGINE REPORT OF AEROMARINE MODEL U-8-D AVIATION ENGINE RATED AT 180 HORSEPOWER AT 1,750 REVOLUTIONS PER MINUTE.

OBJECT.

The object of this test was to obtain complete information concerning the design and performance of the Aeromarine Model U-8-D Engine.

SUMMARY OF RESULTS.

Normal brake horsepower at full throttle, 191.7 brake horsepower at 1,750 revolutions per minute.

Fuel consumption at normal horsepower, 0.474 pound per (actual) brake horsepower hour.

Oil consumption at normal horsepower, 0.0315 pound per (actual) brake horsepower hour.

Brake mean effective pressure at full throttle, normal speed, 117.6 pounds per square inch.

Total weight, dry, 544.6 pounds.

Weight, dry, per normal brake horsepower, 2.84 pounds.

CONCLUSIONS.

The engine appears to fill the requirements of a moderate powered training engine with regard to design and performance. The design is especially good in respect to ease of overhaul and maintenance. No conclusions are possible as to its reliability and durability until a fifty-hour test has been completed, the results of which will be covered in a separate report.

DESCRIPTION.

- Type:
  - Name: Aeromarine.
  - Model: U-8-D.
  - Serial number: 1017 (Mnfr's).
  - Number and arrangement of cylinders: Eight in two banks of four, 60°V.
  - Drive: Direct.
  - Cooling: Water.
  - Cycle: Four-stroke.
  - Fuel: Gasoline.
  - Mounting: Either tractor or pusher.
  - Cannon adaptation: None.
- Manufacturer:
  - The Aeromarine Plane & Motor Co., Keyport, N. J.
- Characteristic features:
  - Cylinder water jackets integral with crank case upper half.
  - Removable steel cylinder liners.
  - Removable en bloc aluminum cylinder heads with cast-iron valve seats.
  - Three-bearing crank shaft.
  - Laminated, double-cantilever valve springs operating four valves per cylinder.
  - Oil circulation through crank shaft, with positive pressure feed to crank-pin bearings.
- Crank case (see figs. 6, 7, 8, and 9):
  - Material—
    - Upper half: Aluminum.
    - Lower half: Aluminum.
  - Location of parting flange: Slightly below crank-shaft center line.
  - Method of clamping: Stud bolts in upper half.
  - Number of crank-shaft bearings: Three.

- Crank case—Continued.
  - Type of bearings: Plain.
  - Material: Babbitt-lined bronze.
  - Method of support: Bearing caps bolted to upper half.
  - Method of securing: Flanged.
  - Method of adjusting: None.
  - Type of oil grooves: One circumferential groove.
  - Engine mounting flanges:
    - Number: Two.
    - Location: Length of crank case, both sides.
    - Type: Integral flanges.
    - Number of bolts in each flange: Eight.
  - Upper half—
    - Type of webs: Double, box section.
    - Bearing caps—
      - Material: Steel forgings with Babbitt-lined bronze bushings.
      - Method of retaining: Studs and flanges.
  - Breathers—
    - Number: Two.
    - Location: Each end of V.
    - Type: Screened holes.
    - Oil passages: One passage from parting line to central main bearing.
  - Lower half:
    - Function: Oil sump and pump support.
    - Type of webs: None.
    - Breathers: None.
    - Compartments: None.
    - Oil passages: Oil pipe from pressure pump to relief valve. Cored passage from relief valve to parting flange. Pipe from strainer to scavenging pump (see fig. 9).
- Crank shaft (see fig. 10):
  - Type: Integral.
  - Material: Forged steel.
  - Method of boring: Straight bored throughout.
  - Method of counterweighing: None.
  - Method of retaining gears: Pump gear by screws—cam shaft drive gear by key and nut.
  - Method of retaining thrust bearing: Nut.
  - Type of thrust bearing: Double race, radial and thrust ball bearing.
  - Thrust-bearing adjustment: Shims.
  - Oil passages to shaft: Crank shaft bored throughout. Crank pins and main journals plugged to retain oil. Short tubes projecting into crank pins to separate dirt from oil by centrifugal action.
- Propeller hub (see fig. 1):
  - Material: Forged steel.
  - Type: Removable, 2-piece, with integral rear flange.
  - Method of securing: Splines and nut.

Connecting rods (see fig. 11):
- Type....Forked and plain.
- Material....Forged steel.
- Section....Tubular.
- Forked rod—
  - Big end arrangement....Marine bearing box with journal for plain rod big end.
  - Type and material of crank-pin bearing....Split babbitt-lined bronze casting
  - Method of securing bearing....Four bolts.
  - Bearing adjustment....None
  - Small end bearing—
    - Type....Plain.
    - Material....Bronze.
    - Retention....Force fit.
    - Adjustment....None.
- Plain rod—
  - Lower end arrangement....Bearing half forged with rod.
  - Lower end bearing—
    - Type....Plain.
    - Material....Steel on bronze.
    - Retention....Two through bolts.
    - Adjustment....None.
  - Upper end bearing....Same as main rod.

Pistons (see figs. 11 and 20):
- Type....Plain trunk.
- Material....Aluminum.
- Internal ribbing....Two across head from pin bosses parallel to pin.
- Rings—
  - Number....Four.
  - Type....Eccentric, diagonal slot.
  - Material....Cast iron.
  - Number and location....Four above pin.
- Oil scrapers and oil holes....One oil groove below pin. Lower ring beveled for oil scraper. Oil holes directly below lower ring.

Piston pin (see fig. 20):
- Material....Forged steel.
- Method of boring....Straight.
- Method of retaining....Free to float, brass plugs at end to prevent scoring cylinder.
- Oil holes....None.

Cylinders (see figs. 4, 5, and 12):
- General—
  - Type....Steel tubes, open at both ends, fitted into aluminum water jackets. Detachable aluminum heads.
  - Method of grouping....Two banks of four, 60° V angle.
  - Method of securing....Jackets cast with crankcase upper half. Cylinder barrel snug fit in jacket. Secured by head casting. Barrels are interchangeable.
- Barrel—
  - Material....Steel.
  - Construction....Flanged to fit water jackets.
- Head—
  - Type and construction....Cast aluminum in blocks of four. Detachable, secured by through bolts
  - Material and construction of valve seats....Iron cast into head.
  - Material and construction of valve ports....Cored into head casting.
  - Material of valve guides....Cast iron.
  - Type of valve guides....Removable, pressed into place.

Cylinders—Continued.
- Head—Continued.
  - Cooling....Water through cored passages around valve ports and guides.
  - Location and construction of spark plug bosses....Hollow brass plugs screwed into head just below valve ports.
- Water jacket—
  - Material....Aluminum.
  - Construction....Cast with crank case upper half.
  - Provisions for expansion....Cork packing at bottom of barrel.
  - Location of water connections....Inlet at top of water jacket casting, outlet at side of head casting.
  - Special features....Steel barrel rests in machined seats in water jacket casting. Cork packing at bottom of barrel.

Drives (see fig. 21):
- Pump drives—
  - Type of gears....Spur.
  - Number and location....One on crank shaft, one on pump shaft.
- Camshaft drive—
  - Type of gears....Bevel.
  - Number and location....Nine—One on crank shaft, two on vertical shaft, two each on inclined shafts, one each on cam shafts (at propeller end).

Valves (see fig. 16):
- Number per cylinder....Four.
- Location....Head.
- Type....Tulip type inlet; mushroom type exhaust.
- Material....Steel.
- Method of securing springs....Steel link through valve stem and over spring end.
- Valve springs—
  - Number per cylinder....Two.
  - Type....Double laminated flat-leaf springs — each spring operates one inlet and one exhaust valve.
- Material....Steel.

Valve gear (see fig. 14):
- Cam shafts—
  - Material....Forged steel.
  - Type....Integral cams.
  - Cam form....Uniform acceleration.
  - Method of boring....Straight bored throughout.
- Cam-shaft housing—
  - Material....Aluminum.
  - Construction (see fig. 14)....Lower half cast with head. Upper half cast in two parts. Aluminum cover over housing.
  - Method of securing....Studs in cylinder head.
  - Number, type, and material of cam-shaft bearings....Six plain babbitt-lined bronze bearings.
  - Method of securing bearings....Recesses for housing bolts.
  - Type and location of rocker-arm bearings....Mounted on spindles—four to each block.
  - Oil passages in housing....From bearings to rocker spindles.
- Rocker arms—
  - Material....Steel.
  - Construction....Double tappets, single cam follower.
  - Type of cam follower....Roller.

Valve gear—Continued.

Rocker arms—Continued.

- Type of tappet........................Floating, with ball joints, fitted in split nuts.
- Adjustment of tappet clearance......Adjustment in split nut at end of rocker.

Valve timing is accomplished by adjustment of the cam shaft bevel gear relative to the cam shaft, by means of a vernier arrangement of the gear retaining screws.

Lubricating system (see fig. 5):

Pressure oil pump—

- Number..............................One.
- Type..................................Gear.
- Material..............................Housing, aluminum; gears, steel.

Scavenging oil pump—

- Number..............................One.
- Type..................................Gear.
- Materials.............................Housing, aluminum; gears, steel.

Strainer—

- Number..............................One.
- Type..................................Cylindrical.
- Material..............................Wire mesh.
- Location.............................Bottom of sump.
- Method of removing..................By plug in crank-case bottom.

Relief valves—

- Number..............................One.
- Type..................................Spring loaded poppet.
- Location.............................Side of sump.
- Method of adjusting..................Screw controlling spring tension.

Main pressure circuit—

Oil from the pressure pump is led through tubing to the relief valve. From the relief valve it passes through cored ducts and tubing to the central main bearing. This bearing has a continuous groove which is always in registry with large oil holes in the crank-shaft journal. There it enters the crank-shaft bore and flows in both directions to lubricate main bearings, crank pins, cam shaft, and drive and thrust bearing. The feeding of oil to the crank shaft from a continuous groove makes possible a maintenance of lubricant pressure at the crank pins as great as that at the main bearings. Holes at each end of the shaft directing oil spray to gears and thrust bearing permit a rapid flow of cool oil through the shaft. At each crank pin a small tube projects slightly into the oil passage to prevent foreign matter from passing through to the crank-pin and wrist-pin bearings. Cylinder walls and wrist pins are lubricated by splash from the crank shaft.

Auxiliary circuit—

Oil for the cam shaft leaves the crank-shaft bore at the propeller end and is conducted through a copper tube in the water jacket casting to the rear cam-shaft bearing. At this point it enters the cam-shaft bore and flows the length of the shaft to lubricate bearings and valve gear. Excess oil from the cam-shaft housing drains down the inclined shaft housing at the front, lubricating the gear train. The thrust bearing is lubricated directly from the crank-shaft oil passage. Lubrication is supplied to the water pump by a grease cup. The scavenging pump takes its suction from the bottom of the oil sump through a cylindrical wire-mesh strainer.

Cooling system (see figs. 4 and 5):

Water pump—

- Number..............................One.
- Type..................................Centrifugal.
- Materials.............................Aluminum housing and impeller.
- Location.............................Rear of crank case.
- Type of stuffing box..................Bronze and fiber bushings with sealing grooves cut in pump shaft.

Main circulation system—

The pump takes its suction through a single inlet around the shaft and discharges through double outlets to the tops of the cylinder water jackets. The water entering the cylinder block jacket is distributed evenly throughout the jacket by a perforated tube. Additional admission of water to the jackets is provided by small pipes leading from the pump discharges and entering the lower portion of the jackets at the pump end. From the cylinder jackets the water passes to the heads through cored passages past the cylinder head joint. Outlet flanges are provided at both ends of the head inside the "V."

Auxiliary system—

An auxiliary system to heat the intake manifold takes its water supply from the head jacket of the left block. To facilitate the circulation the outlet from the manifold jacket is led directly to the pump inlet pipe.

Intake manifolds (see fig. 19):

- Number..............................Two.
- Location.............................Outside of blocks.
- Type..................................Unbaffled, straight gallery.
- Materials.............................Aluminum.
- Water jacketing......................None on outer headers.
- Type of flanges......................Integral.
- Method of removing..................Attached by studs.
- Material of gaskets..................Fiber.

NOTE.—An additional carburetor "T" manifold conducts the fuel mixture from the carburetor to cored passages in each head which lead to the outer manifolds. A water jacket is fitted at the top of this manifold.

Carburetors (see fig. 19):

- Number..............................One.
- Name..................................Zenith.
- Type..................................Duplex, automobile type without mixture control.
- Manufacturer.........................Zenith Carburetor Co., Detroit, Mich.
- Materials—
  - Body..................................Aluminum.
  - Nozzle................................Brass.
  - Jets..................................Brass.
- Type of strainer......................Cylindrical wire mesh.
- Method of removing strainer...........Held by brass cap.

Main jet system—

Fuel flows from the bottom of the float chamber through the bottom of the idling well to the main jet in the base of the main nozzle. The compensating jet is carried in the base of the idling well and communicates through a small passage with the compensating nozzle surrounding the main nozzle. It receives its fuel from the main fuel passage.

The idling tube carried in the idling well is supplied with fuel by the compensating jet. It communicates with the throat passage just above the throttles. Idling adjustment is accomplished by regulation of variable orifices in the top of the idling tube. The venturi is removable. The throttle is a plain butterfly valve. No mixture control is fitted on the carburetor used in the dynamometer tests.

Ignition:

- Name of system.......................Dixie.
- Type..................................Magneto.
- Manufacturer.........................Splitdorf Electrical Co., Newark, N. J.
- Model..................................860.
- Number of magnetos...................Two.
- Number of cylinders and plugs per cylinder fired by each.......One plug each, eight cylinders.
- Type of magnetos......................Inductor.
- Rotation...............................Opposite.
- Timing adjustments....................By varying bolt positions in couplings.
- Spark advance and retard mechanism....None.

Spark plugs:

- Name..................................A. C.
- Manufacturer.........................Champion Ignition Co., Flint, Mich.
- Number per cylinder...................Two.
- Material of insulator.................Porcelain.
- Material of body......................Steel.
- Type of gap...........................Single; cross bar grounded electroded.
- Type of terminal correction...........Ball.

Auxiliaries (see figs. 1, 2, and 3):

Tachometer drives—

- Number..............................Two.
- Location.............................Rear end of cam shafts.

Auxiliaries (see figs. 1, 2, and 3)—Continued.
- Starter—
  - Type.......... Electric, mounted on magneto bracket casting.
  - Manufacturer.......... Bijur Motor Appliance Co., Hoboken, N. J.

Airplane mounting:
- Type of mounting required.......... Straight engine bearers.
- Connections and controls—
  - Carburetor controls—
    - Number.......... Two.
    - Nature.......... Throttle and altitude control.
    - Location.......... In V
    - Type.......... Thrust rods.
  - Tachometer connections—
    - Number.......... Two.
    - Location.......... Rear of cam shafts.
  - Cooling-system connections—
    - Inlet—
      - Number.......... One.
      - Location.......... Water pump.
    - Outlet—
      - Number.......... Two.
      - Location.......... Front or rear of cylinder head castings.
  - Exhaust system—
    - Type of manifolds to be used.......... Vertical pipes in V
- Connections and controls—
  - Lubrication system connections—
    - Number (dry sump system)—
      - Inlet.......... One.
      - Outlet.......... One.
      - Pressure gage.......... One.
      - Location.......... Rear end of crank case.
  - Fuel-system connections—
    - Number.......... One.
    - Location.......... In V
  - Ignition-system connections—
    - Number.......... Two, ground wires.
    - Location.......... Magneto breaker boxes.
  - Starter connections—
    - Number.......... One, cable from starting switch to starting motor.

METHOD OF TEST.

The engine was connected to an electric cradle dynamometer and the following runs made:

- 2 full-power runs.
- 2 propeller load runs.
- 1 friction horsepower run.
- 1 one-hour fuel and oil consumption run.
- 1 oil pump capacity run.
- 1 water pump capacity run.

Readings were made in accordance with standard methods completely described in Engineering Division Report, Serial No. 1507.

RESULTS OF TESTS.

The results of the tests are given concisely in the tables, pages 8–10, and curves, pages 22–26. It should be remembered that the laboratory conditions of test are much more favorable to satisfactory performance than are those of actual flight so that these results may be assumed to be slightly better than the normal operating performance of the engine. Since no reliable method has yet been proposed for applying corrections to errors resulting from air temperature variations, no such corrections have been made. The air temperature on test, however, was very near to the standard temperature of 60° F., and the error due to this cause is probably negligible.

OBSERVATIONS ON TEST.

The engine operation was very satisfactory. Two slight water leaks through the cylinder water jacket casting at the outer side of the left bank (center) and at the oil tube to the valve gear (left bank) were discovered during the one hour consumption run. No oil leakage was noted. The engine in the matter of smoothness compares favorably with service engines of similar construction and power.

TEAR-DOWN INSPECTION.

At the completion of the runs listed the engine was disassembled for inspection. All parts were found to be in excellent condition. The principal bearing surfaces were only slightly scratched and barely perceptible wear was noted on gears.

ANALYSIS OF ENGINE.

DESIGN.

Valve gear.—The valve gear with laminated flat springs appears to operate satisfactorily. Its chief advantage lies in the ease with which springs can be removed.

Cylinder head casting.—The extremely small cooling water passages in the head seem likely to prove troublesome, due to accumulation of sediment, when very hard or otherwise impure water is used for cooling. The removable head greatly simplifies the matter of top overhaul.

Connecting rods.—The small clearance afforded in the forked end of the main rod makes it necessary to remove the bronze box from this rod before the plain rod big end can be dismantled.

Adaptability to production.—No particularly difficult or expensive manufacturing processes are apparent in the engine construction. Cylinder, crank-case halves, and jackets are very simple. The connecting rods are of marine straddle type and therefore easily constructed. The head castings alone present any considerable difficulties, the foundry work being rather complex due to the nature of the ports and water passages.

PERFORMANCE ON TEST.

A comparison of the performance of this engine with that of the Hispano-Suiza model "E" follows:

	Hispano-Suiza model "E."	Aeromarine U-8-D
Brake horsepower at 1,800 revolutions per minute	189.9	199.5
Specific fuel consumption, pounds per horsepower per hour at 1,800 revolutions per minute	.493	.467
Oil consumption, pounds per horsepower per hour (normal speed)	.0193	.0315
Brake horsepower at 1,800 revolutions per minute per cubic inch piston displacement	.264	.270
Weight, pounds per brake horsepower	2.510	2.722
Brake mean effective pressure pounds per horsepower at 1,800 revolutions per minute	116.20	118.80

ADAPTABILITY TO AIRPLANE.

The engine is of clean design, easily mounted and easily streamlined. Its head resistance, 3.5 square feet, is rather low.

ACCESSIBILITY.

The spark plugs and carburetor are easily accessible with the engine mounted. Valve adjustments necessitate the removal of the head covers. The magnetos at the

rear of the engine face with distributors outward and so are readily reached through the cowling. The oil strainer is secured by cap screws in the bottom of the crank case and may readily be withdrawn for cleaning. The oil pressure relief valve is located at the side of the crank case just below the parting flange, and is, therefore, accessible. Water pump removal requires the removal of the magneto and starter gear housing.

SERVICE.

The engine is easily overhauled. Top overhaul is particularly simple, due to the removable heads and flat valve springs. In maintaining this engine in the field, cylinder heads requiring valve grinding or other repairs could be replaced by heads in good condition in a very short time and without removing the engine from the airplane. Complete overhaul is simplified by the removable heads, the clean crank-case design, and the simplicity of the drive layout. The removable heads, however, seem likely to give trouble in maintaining a tight gasket surface between cylinders and heads, particularly at the water jacket joints. Some leakage there has already been noted on further tests of the engine.

For service use this engine should be fitted with a carburetor with altitude control. The jet setting also will probably require enriching for satisfactory service operation.

AEROMARINE ENGINE WEIGHTS.

		Pounds.	Per cent.
Crank-case group:			
Upper half with water jackets, cylinder barrels, bearings, etc	147.5		
Lower half with oil filter and relief valve	20.2		
Total		167.7	30.8
Crank-shaft group:			
Crank shaft with gears, thrust bearing, etc		65.4	12.0
Propeller hub assembly, complete		9.9	1.8
Connecting-rod group:			
4 connecting-rod assemblies averaging 7.4 pounds each		29.6	5.4
Piston group:			
8 piston assemblies, complete, with rings averaging 2.56 pounds each		20.5	3.8
Cylinder-head group:			
2 head castings, including bearings, valves, rocker levers, springs, etc	119.6		
2 head covers	19.5		
Total		139.1	25.5
Driving-gear group:			
Vertical shafts and gears	4.8		
Inclined shafts and gears	4.2		
Starter gear and magneto drive assembly	11.4		
Total		20.4	3.8
Lubrication group:			
1 oil pump assembly, complete		5.3	1.0
Cooling-system group:			
1 water pump assembly	3.6		
Water manifolds and piping	8.8		
Total		12.4	2.3
Carburetor and intake group:			
1 carburetor assembly	5.4		
1 intake T manifold	5.1		
2 intake headers	8.2		
Total		18.7	3.4
Ignition group:			
2 magneto assemblies	42.9		
16 spark plugs	2.7		
Distributor covers and wires	7.7		
Total		53.3	9.8
Miscellaneous nuts, bolts, washers, etc		2.3	.4
Engine, total		544.6	100.0
Weight of water in engine		47	....

POWER PLANT WEIGHT.

1. Engine weight, dry .... pounds.. 544.6
2. Power plant constant weight: Pounds.
   - (a) Oil radiator and piping 10.0
   - (b) Air intake pipes 3.8
   - (c) Hand starting magneto 8.0
   - (d) Exhaust stacks 8.0
   - (e) Fuel system 50.0
   - (f) Engine controls 8.0
   - (g) Instruments 8.0

   Total .... pounds.. 95.8
3. Cooling system .... do.... 124.7
4. Fuel, oil and tankage:
   - (a) Fuel—
     - Pounds per hour at sea level 91.0
     - Pounds per hour at 10,000 feet 68.1
     - Pounds per hour at 15,000 feet 61.1
   - (b) Oil—
     - Pounds per hour 6.04
     - 3 gallon reserve 22.0
   - (c) Fuel tanks—
     - Gravity tank .... pounds.. 18.2
     - Leak-proof tank per pound fuel .... do.... .345
   - (d) Oil tanks—
     - Per pound oil .... do.... .267

POWER PLANT WEIGHT (POUNDS) BY CLASS OF SERVICE.

	Pursuit.[1]	Two-place.[2]	Bombing.[3]	Training.[4]	Long-distance cruising.[5]
Engine weight, dry	544.6	544.6	544.6	544.6	544.6
Power plant constant weight	95.8	95.8	95.8	95.8	95.8
Cooling system	124.7	124.7	124.7	124.7	124.7
Tankage	97.3	141.0	166.1	195.8	543.2
Fuel	198.3	317.9	386.0	227.5	1,407.5
Oil	40.1	49.2	55.2	37.1	145.9
Total	1,100.8	1,273.2	1,372.4	1,225.5	2,861.7
Per horsepower	5.74	6.64	7.16	6.39	14.92

[1] ½ hour at sea level, 2½ hours at 15,000 feet.
[2] ½ hour at sea level, 4 hours at 10,000 feet.
[3] ½ hour at sea level, 5 hours at 10,000 feet.
[4] 2½ hours at sea level.
[5] ½ hour at sea level, 20 hours at 10,000 feet.

DIMENSIONS.

General:
- Bore .... inches.. 4.25.
- Stroke .... do.... 6.50.
- Compression ratio .... 5.38:1.
- Rotation of propeller (facing propeller)... Counterclockwise.
- Total piston displacement.. cubic inches.. 738.0.
- Approximate head resistance. square feet.. 3.5.
- Firing order .... 1L-4R-3L-2R-4L-1R-2L-3R.
- Method of numbering cylinders .... (See fig. 3.)

Crank case:
- Distance between cylinder center—
  - 1-2 and 3-4 .... inches.. 4.75.
  - 2-3 .... do.... 8.00.
- Diameter main bearing studs ...... inch.. 0.50.
- Main crank-shaft bearings—

No.	Diameter.	Length.	Diametral clearance.	End clearance.	Projected area.
	Inches.	*Inches.*	*Inch.*	*Inch.*	*Square inches.*
1	2.506	2.500	0.006	0.05	6.265
2	2.505	3.062	.005	.188	7.680
3	2.506	2.500	.006	....	6.265

Engine hold-down bolts: Number 16, diameter, 0.4375 inch.

Crank shaft:

No.	Outside diameter.	Length.	Diameter bore.
	Inches.	*Inches.*	*Inches.*
Main journals:			
1	2.500	2.550	1.750
2	2.500	3.250	2.000
3	2.500	3.563	2.000
Crank pins:			
1	2.500	2.510	1.750
2	2.500	2.510	1.750
3	2.500	2.510	1.750
4	2.500	2.510	1.750

Crank cheeks:

	Inches.
Width—	
1, 3, 4, and 6	3.500
2 and 5	3.000
Thickness—	
1, 3, 4, and 6	1.000
2 and 5	2.000
Length of shaft, front end to first crank cheek	16.625

Thrust bearing:
Manufacturer and number.....Hess Bright, No. 8312.

Propeller hub mounting (see fig. 1):
Two removable cones with splines on crank shaft and hub.
Length of bearing surface of cones, parallel to shaft—
Rear.....inch..0.3125.
Front.....do....0.750.
Diameter—
Front cone.....inches..2.125 x 2.893.
Rear cone.....do....2.4375 x 2.740.

Propeller hub:
Diameter hub body.....inches..2.500.
Length between flanges.....do....5.00-5.50.
Diameter bolt circle.....do....6.000.
Number of bolts.....8.
Diameter of bolts.....inch..0.440.

Connecting rods:
Length of plain rod, center to center.....inches..12.00.
Number of bolts.....2.
Minimum diameter of shank.....inch..0.4375.
Threads, per inch.....20.
Length of forked rod, center to center.....inches..12.00.
Number of bolts.....4.
Minimum diameter of shank.....inch..0.375.
Threads, per inch.....24.
Rod-stroke ratio.....1.846 : 1.

Wrist-pin bushing:
Length.....inches..1.750.
Diameter.....do....1.128.
Projected area.....square inches..1.975.
End play of rod on pin.....inch..0.125.

Big end bearing, plain rod:
Length.....inches..1.250.
Diameter.....do....2.875.
Diametral clearance on forked rod...inch..0.008.
End clearance in forked rod.....do....0.018.

Big end bearing, forked rod:
Length.....inches..2.495.
Clearance on crank pin—
Diametral.....inch..0.005.
End.....do....0.005.
Projected area on crank pin..square inches..6.24.

Pistons:
Area of head.....do....14.08.
Distance, center of pin to top of piston.....inches..2.000.
Length over all.....do....3.750.
Length of bearing in cylinder.....do....3.250.
Clearance in cylinder—
Top.....inch..0.017.
Botton.....do....0.010.

Rings:
Number per piston.....4.
Tension.....pounds..5.25.
Width.....inch..0.125.
Width of gap, ring in cylinder.....do....0.035.

Pin:
Length—
Ground surface.....inches..3.9375.
Over-all.....do....4.190.
Diameter.....do....1.118.
Diameter, bore.....inch..0.571.
Total length of bearing in piston...inches..2.0625.

Cylinders:
Bore.....inches..4.250.
Stroke.....do....6.500.
Stroke-bore ratio.....1.529 : 1.
Piston displacement of engine.....cubic inches..738.0.
Piston displacement of cylinder.....do....92.25.
Compression volume of cylinder.....do....21.06.
Compression ratio.....5.38 : 1.
Per cent compression.....18.58.

Port openings:	Intake.	Exhaust.
Number per cylinder	2	2
Diameter.....inches..	1.750	1.625
Water connections:	**Inlet.**	**Outlet.**
Number	4	4
Inside diameter.....inches..	0.500 and 1.4375	1.000

Minimum thickness of water space around cylinder barrel.....inch..0.250.

Cylinder-head hold-down studs: Number, 24—12 in each head; diameter, 0.4375 inch; threads per inch, 20.

Drive gears:

Gear.	Type.	Pitch diameter.	Number of teeth.	Face width at pitch line.	Minimum diameter of shaft.
		Inches.		*Inch.*	*Inches.*
C. S. auxiliary drive	Bevel.	4.125	33	0.500	2.9375
Vertical shaft—					
Lower	...do..	2.750	22	.55	.131
Upper	...do..	2.750	22	.45	.131
Inclined shaft—					
Lower	...do..	2.750	22	.45	.797
Upper	...do..	1.625	13	.500	1.00
Cam-shaft gear	...do..	4.875	39	.500	1.092
Crank-shaft pump gear	Spur..	4.500	45	.250	2.500
Pump gear	...do..	4.000	40	.250	
Magneto drive gear	Hel...	2.307	15		
Magneto shaft gear	...do..	2.307	15		

Cam shaft:
Outside diameter.....inches..1.25
Bore diameter.....inch...625

Journals—

Number.	Diameter.	Length.
	Inches.	*Inches.*
1	1.250	2.500
2	1.250	2.625
3	1.250	1.6875

Bearings—

Number.	Length.
	Inches.
1	2.250
2	2.500
3	1.625

Cams—

	Body, diameter.	Width.	Lift.
	Inches.	*Inch.*	*Inch.*
Intake	1.250	0.3125	0.288
Exhaust	1.250	.3125	.288

Rocker arms—	Inches.
Length valve lever	1.375
Length cam lever	.875
Diameter spindle	.500

Valves:

	Inlet.	Exhaust.
Number per cylinder	2	2
Outside diameter ... inches	1.8375	1.780
Inside diameter ... do	1.700	1.575
Lift ... inch	.4375	.4375
Angle of seat	30°	30°
Angle of stem with cylinder axis	25°	25°
Total area of opening, square inches both valves	2.25	2.10
Stem diameter ... inch	.343	.405
Tappet, clearance ... do	.013	.013

Valve springs—
- Number per cylinder ... ½
- Tension inlet—
  - Valve open ... pounds .. 45
  - Valve closed ... do 30
- Tension exhaust—
  - Valve open ... do 45
  - Valve closed ... do 30

Valve timing—

	Designed.	Actual (average).
Inlet—		
Opens	10° ATC	11.4° ATC.
Closes	42° ABC	41.9° ABC.
Exhaust—		
Opens	45° BBC	47.4° BBC.
Closes	10° ATC	7.6° ATC.

Oil pump:

	Pressure.	Scavenging.
Number and type	1	1.
Material—		
Casing	Aluminum	Aluminum.
Gears	Steel	Steel.
Speed	9/8 C. S.	9/8 C. S.
Number of gears	2	2.
Pitch diameter of gears ... inches	1.625	1.625.
Number of teeth	8	8
Face width ... inch	0.6875	1.625.

Oil connections from engine to tank—
- Inside diameter— Inches.
  - Inlet ... 0.594
  - Outlet ... .750

Water pump:
- Material—
  - Housing ... Aluminum.
  - Rotor ... Aluminum.
- Type ... Centrifugal.
- Speed ... 9/8 C. S.
- Diameter, rotor ... inches .. 4.00
- Number of vanes ... 6
- Width of vanes at tip ... inch .. .875
- Number of inlets, inside diameter ... inches .. 1-1.25
- Number of outlets, inside diameter ... do 2-1.25
- Diameter of shaft ... inch .. .5625

Water connections to engine:

	Number.	Inside diameter.	Outside diameter.
		Inches.	*Inch.*
Inlet	2	0.500	0.5625
Outlet	2	1.4375	....
	2	1.00	....

Carburetor:
- Number ... 1.
- Material, body ... Aluminum.
- Diameter at flange, inside ... inches .. 1.875.
- Choke diameter ... do .... 1.250.
- Metering jets, material ... Brass.
  - Diameter—
    - Main ... mm .. 1.50.
    - Compensating ... do .... 1.60.

Ignition:
- Number of magnetos ... 2.
- Speed rotor ... Crank shaft.
- Speed distributor ... 1/2 C. S.
- Width of breaker gap ... inch .. 0.021.

Spark plugs:
- Size of thread ... Metric (S. A. E. std.).
- Gap ... inch .. 0.018.

Auxiliaries:
- Tachometer drive connection—
  - Speed ... 1/2 C. S.
  - Outside diameter threads ... inch .. 0.875.
  - Pitch of threads ... per inch .. 18.

Reciprocating and centrifugal weights:

	Pounds.
Piston, complete with rings and pin	2.51
Upper end of forked connecting rod	1.20
Upper end of plain connecting rod	1.00
Lower end of forked connecting rod	3.29
Lower end of plain connecting rod	1.90
Connecting rod total weights—	
Forked	4.49
Plain	2.90
Total	7.39
Valve, without spring	.25
Weight of spring assembly, for two valves	.50

ENGINE EFFICIENCY TABLE.

Cubic inches piston displacement per brake horsepower at normal speed (1,600 revolutions per minute)	3.850
Brake horsepower per cubic inch piston displacement at normal speed	.2597
Brake horsepower per cubic foot of piston displacement at normal speed	449.0
Brake horsepower per square foot of piston area at normal speed	217.0
Indicated mean effective pressure at normal speed .. lb./sq. in.	136.2
Friction mean effective pressure at normal speed ... do	18.58
Brake thermal efficiency at normal speed ... per cent	28.3
Indicated thermal efficiency at normal speed ... do	32.4
Air standard efficiency ... do	49.67
Efficiency ratio (indicated)	.6525
Efficiency ratio based on brake thermal efficiency	.5700
Mechanical efficiency ... per cent	86.4

FULL POWER RUNS.

FIRST RUN.

R. p. m.	Actual—		Corrected—			Water.		Oil.			Carb. air temp. ° F.	Man. vac. in Hg.	Carb. vac. in Hg.	Gas. cons.		
	Brake load lb.	B. hp.	Torque, lb.-ft.	Hp.	B. m. e. p., lb. per sq. in.	Temp. ° F. In.	Temp. ° F. Out.	Temp. ° F. In.	Temp. ° F. Out.	Press. lb. per sq. in.				Sec. for 3 lb.	Lb. hp.-hr.	Lb. per hr.
1,249......	348.0	144.9	621.7	147.8	126.9	125	142	120	124	38	56	0.9	1.0	138.0	0.540	78.3
1,357......	354.0	160.1	632.2	163.3	129.2	121	138	116	126	42	56	1.2	1.1	135.6	.498	79.7
1,458......	354.0	172.0	632.2	175.5	129.2	120	144	146	144	38	56	1.4	1.2	131.8	.476	81.9
1,560......	344.0	178.8	614.2	182.4	125.5	127	141	132	138	45	56	1.4	1.2	127.5	.473	84.7
1,667......	334.5	185.8	597.2	189.6	122.1	126	140	142	142	43	56	1.5	1.3	123.5	.470	87.5
1,760......	327.5	192.1	584.7	196.0	119.5	125	139	143	145	46	56	1.6	1.4	119.2	.471	90.6
1,878......	320.0	200.3	571.5	204.4	116.8	128	142	144	147	47	57	1.7	1.5	116.5	.463	92.7
1,979......	309.5	204.2	552.5	208.3	112.9	126	141	145	148	49	58	1.9	1.6	111.0	.476	97.3
2,082......	294.5	204.4	526.0	208.6	107.5	124	139	145	150	49	58	2.2	1.9	105.3	.502	102.6

Average barometer, 29.32 in. Hg.

SECOND RUN.

R. p. m.	Actual—		Corrected—			Water.		Oil.			Carb. air temp. ° F.	Man. vac. in Hg.	Carb. vac. in Hg.	Gas. cons.		
	Brake load lb.	B. hp.	Torque, lb.-ft.	Hp.	B. m. e. p., lb. per sq. in.	Temp. ° F. In.	Temp. ° F. Out.	Temp. ° F. In.	Temp. ° F. Out.	Press. lb. per sq. in.				Sec. for 3 lb.	Lb. hp.-hr.	Lb. per hr.
1,259......	350.0	146.9	624.6	149.8	127.7	124	142	134	136	32	58	0.9	1.0	144.5	0.509	74.7
1,354......	357.5	161.4	638.5	164.6	130.4	125	141	153	160	32	58	1.2	1.1	136.5	.490	79.1
1,463......	354.0	172.6	631.6	176.0	129.1	124	140	155	158	33	58	1.4	1.2	129.8	.482	83.2
1,558......	349.0	181.2	623.0	184.7	127.2	125	140	156	156	35	58	1.5	1.2	111.4	.535	96.9
1,662......	337.0	186.7	601.7	190.4	122.8	126	141	154	155	39	59	1.5	1.3	122.5	.472	88.2
1,765......	328.0	193.0	585.5	196.8	119.6	127	140	153	153	41	59	1.6	1.4	119.5	.468	90.4
1,865......	319.5	198.6	570.0	202.5	116.5	128	141	151	151	42	59	1.7	1.5	113.0	.481	95.6
1,965......	309.0	202.4	552.4	206.4	112.8	127	141	150	151	45	59	1.9	1.6	110.8	.481	97.5
2,077......	296.0	204.9	528.3	209.0	107.9	124	141	150	151	47	59	2.1	1.8	104.7	.503	103.2

Average barometer, 29.32 in. Hg.

PROPELLER LOAD RUNS.

FIRST RUN.

R. p. m.	Actual—		Corrected—		Water.		Oil.			Carb. air temp. ° F.	Man. vac. in. Hg.	Carb. vac. in. Hg.	Gas. cons.		
	Brake load lb.	B. hp.	Torque, lb.-ft.	Hp.	Temp. ° F. In.	Temp. ° F. Out.	Temp. ° F. In.	Temp. ° F. Out.	Press. lb. per sq. in.				Sec. for 3 lb.	Lb. hp.-hr.	Lb. per hr.
1,766..............	327.0	192.5	584.0	196.4	130	143	152	150	42	60	1.6	1.4	120.4	0.466	89.7
1,666..............	289.5	160.8	517.2	164.1	123	137	150	150	41	60	2.9	1.0	142.0	.473	76.1
1,554..............	256.5	132.9	458.2	135.6	125	138	148	148	41	60	5.7	.6	164.3	.494	65.7
1,449..............	225.0	108.7	402.0	110.9	129	141	145	145	40	60	8.0	.5	195.0	.509	55.4
1,340..............	194.0	86.7	346.4	88.5	124	138	143	144	39	60	10.2	.4	238.0	.524	45.4
1,243..............	166.5	69.0	297.2	70.4	129	140	142	144	37	60	11.9	.3	245.0	.639	44.1

Average barometer, 29.32 in. Hg.

SECOND RUN.

R. p. m.	Actual—		Corrected—		Water.		Oil.			Carb. air temp. ° F.	Man. vac. in. Hg.	Carb. vac. in. Hg.	Gas. cons.		
	Brake load lb.	B. hp.	Torque, lb.-ft.	Hp.	Temp. ° F. In.	Temp. ° F. Out.	Temp. ° F. In.	Temp. ° F. Out.	Press. lb. per sq. in.				Sec. for 3 lb.	Lb. hp.-hr.	Lb. per hr.
1,778..............	327.0	193.8	584.0	197.8	129	142	147	150	44	60	1.6	1.4	119.0	0.468	90.8
1,658..............	289.0	159.7	516.0	162.9	120	134	150	150	42	60	2.9	1.0	134.6	.502	80.3
1,547..............	256.0	132.0	457.1	134.7	124	137	136	140	41	60	5.6	.7	162.7	.503	66.4
1,444..............	224.0	107.9	400.0	110.1	128	140	122	130	42	61	8.0	.5	189.5	.528	57.0
1,347..............	194.0	87.2	346.4	89.0	126	139	106	116	44	61	10.1	.4	198.6	.624	54.4
1,248..............	167.0	69.5	298.2	70.9	125	137	125	126	37	61	12.0	.3	249.4	.623	43.3

Average barometer, 29.32 in. Hg.

FRICTION HORSEPOWER RUN.

Tachometer, r. p. m.	Corrected engine, b. hp. (from curve).	Friction load, lb.	Friction, hp.	F. m.e. p, lb. per sq. in.	Per cent, mech. eff.	Water.		Oil.	
						Temp., °F.		Temp., °F.	
						In.	Out.	In.	Out.
1,250	148.0	41	17.1	14.7	89.7	142	143	112	120
1,350	163.0	43	19.4	15.4	89.4	139	140	116	121
1,450	174.5	44	21.3	15.8	89.1	139	140	129	128
1,550	183.0	44	22.7	15.7	89.0	140	141	133	134
1,650	190.0	48	26.4	17.2	87.8	140	142	143	142
1,750	196.0	52	30.3	18.6	86.6	138	140	156	152
1,850	201.0	64	39.5	22.9	83.6	139	140	155	155
1,950	205.0	67	43.6	24.0	82.5	140	142	151	153
2,050	208.2	65	44.4	23.2	82.5	142	144	147	153

Length of brake arm, 21 inches; kind of oil used, United States Spec. No. 3501; average barometer, 29.32 in. Hg.; average carburetor air temperature, 60 °F.

ONE HOUR FUEL AND OIL CONSUMPTION RUN.

Time, min.	R. p. m.	Actual—		Corrected—		Water.		Oil.			Carb. air temp., °F.	Man. vac. in. Hg.	Carb. vac. in. Hg.	Gas cons.		Oil cons.	
		Brake load, lb.	B. hp.	Hp.	B. m. e. p., lb. per sq. in.	Temp., °F.		Temp., °F.		Press., lb. per sq. in.				Scale reading, lb.	Lb. hp.-hr.	Scale reading, lb.	Lb. hp.-hr.
						In.	Out.	In.	Out.								
0	1,778	317	187.9	191.7	115.7	127	140	108	122	60	64	1.6	1.4	124.0	......	13.0	......
5	1,768	316	186.3	190.0	115.3	127	142	126	139	61	64	1.6	1.4	116.6	0.475	13.1	......
10	1,774	322	190.4	194.4	117.6	126	140	120	136	61	64	1.6	1.4	108.8	.492	12.4	......
15	1,765	323	190.0	193.9	117.8	128	142	140	149	61	62	1.6	1.4	101.3	.473	12.5	......
20	1,781	323	191.7	195.5	117.8	124	139	134	146	61	62	1.6	1.4	93.8	.472	11.4	......
25	1,776	322	190.6	194.5	117.5	126	140	129	140	61	62	1.6	1.4	86.4	.465	12.0	......
30	1,775	325	192.3	196.2	118.6	128	141	159	158	61	61	1.6	1.4	78.9	.470	11.4	......
35	1,772	325	192.0	195.9	118.6	125	139	151	156	61	61	1.6	1.4	71.5	.462	10.3	......
40	1,780	324	192.2	196.1	118.3	124	138	150	154	61	61	1.6	1.4	64.0	.468	9.2	......
45	1,765	324	190.6	194.5	118.2	125	139	149	153	61	60	1.6	1.4	56.4	.476	8.6	......
50	1,769	323	190.5	194.4	117.9	129	142	148	151	61	60	1.6	1.4	48.9	.473	8.1	......
55	1,769	323	190.5	194.4	117.9	125	139	147	151	61	60	1.6	1.4	41.3	.479	7.3	......
60	1,765	322	189.5	193.3	117.5	125	138	146	150	61	60	1.6	1.4	33.8	.474	7.0	......
AVERAGE RESULTS FOR 1 HOUR.																	
1	1,772	322.2	190.3	194.2	117.6	126.1	139.9	139.0	146.5	61	61.6	1.6	1.4	[1] 90.2	0.474	[1] 6.0	0.0315

[1] Total for 1 hour.

Average barometer, 29.32 in. Hg.
Data for all runs: Length of brake arm, 21 inches; kind of oil used, United States Spec. No. 3501; specific gravity gasoline, 0.703 at 60 °F.

OIL PUMP CAPACITY RUN—PUMPING THROUGH ENGINE.

R. p. m.	Water.		Oil.			Oil flow.		Oil flow, lb. per hr.
	Temp., °F.		Temp., °F.		Press., lb. per sq. in.	Lb.	Sec.	
	In.	Out.	In.	Out.				
1,229	136	138	138	139	60	5	11.4	1,579
1,501	137	139	134	138	61	5	10.0	1,800
1,654	139	140	136	140	61	5	9.4	1,915
1,877	140	142	136	141	62	5	8.7	2,069
2,049	140	143	138	144	63	5	8.2	2,195

OIL PUMP CAPACITY RUN—FREE OUTLET.

Engine, r. p. m.	Pump, r. p. m.	Torque, lb. ft.	Horse-power.	Capacity, lb. per hour.	Temperature, °F.
PRESSURE PUMP.					
1,250	1,406	1.7	0.46	2,140	100
1,450	1,630	1.9	.59	2,430	....
1,650	1,850	2.1	.74	2,610	104
1,850	2,080	2.2	.87	2,950	....
2,050	2,305	2.5	1.10	3,050	110
SCAVENGE PUMP.					
1,250	1,406	2.2	0.59	5,000	90
1,450	1,630	2.4	.75	5,450	....
1,650	1,850	2.7	.95	5,810	94
1,850	2,080	2.9	1.15	6,920	102
2,050	2,305	3.0	1.32	7,500	110

Oil specific gravity, 0.870.

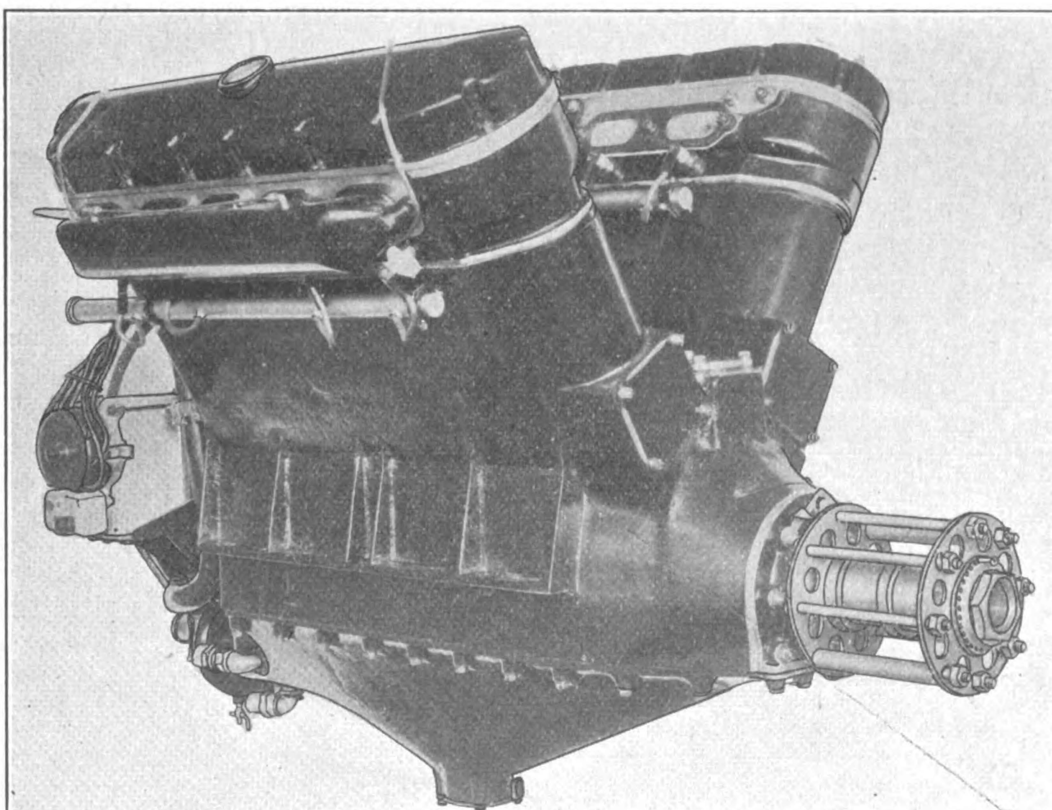


FIG. 1.—Three-quarter front view.

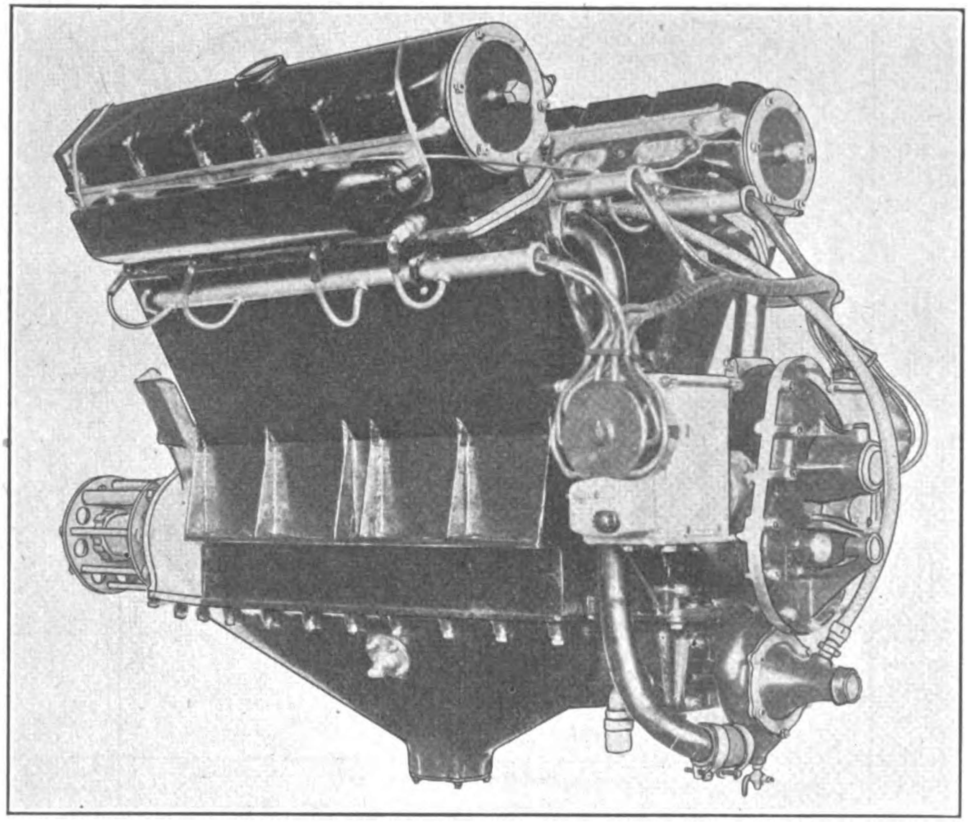


FIG. 2.—Three-quarter rear view.

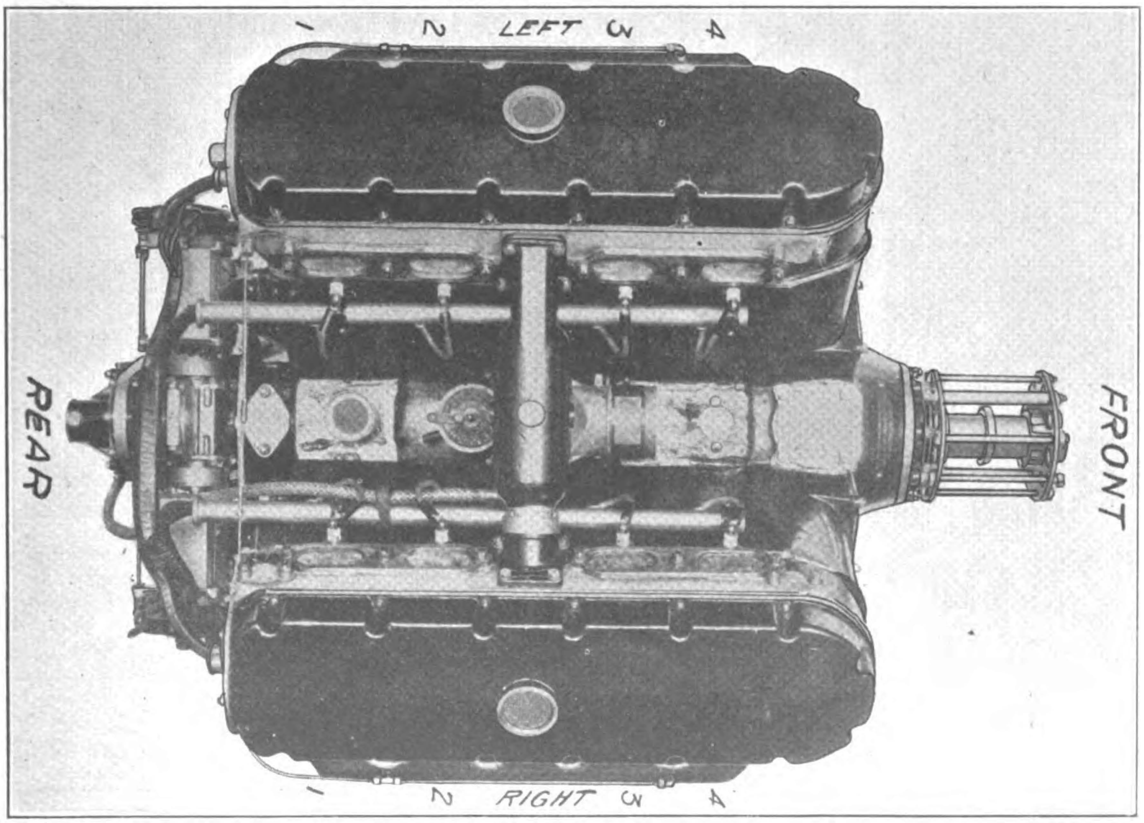


FIG. 3.—Top view.

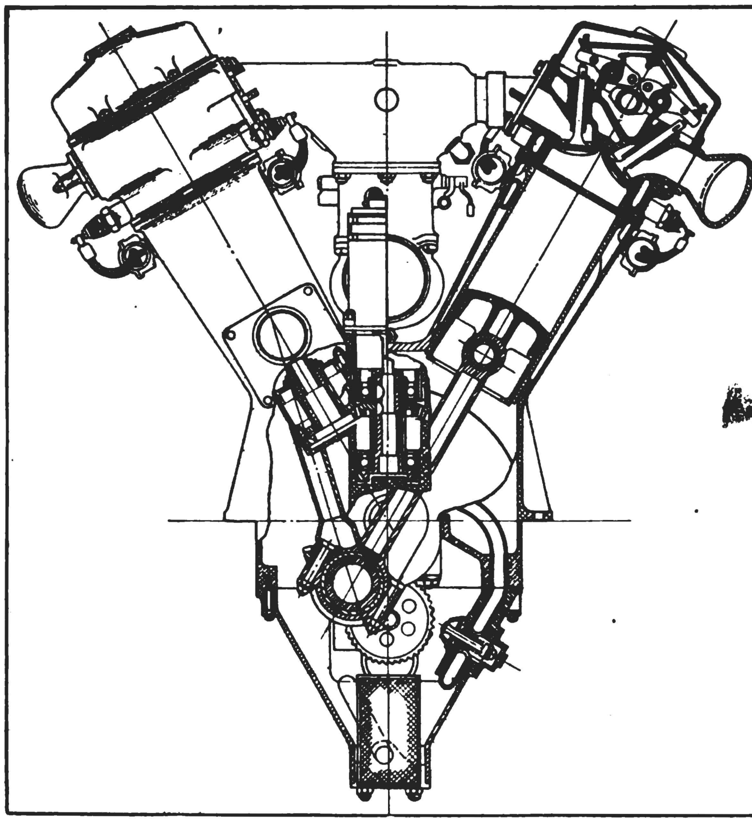


FIG. 4.—Vertical section.

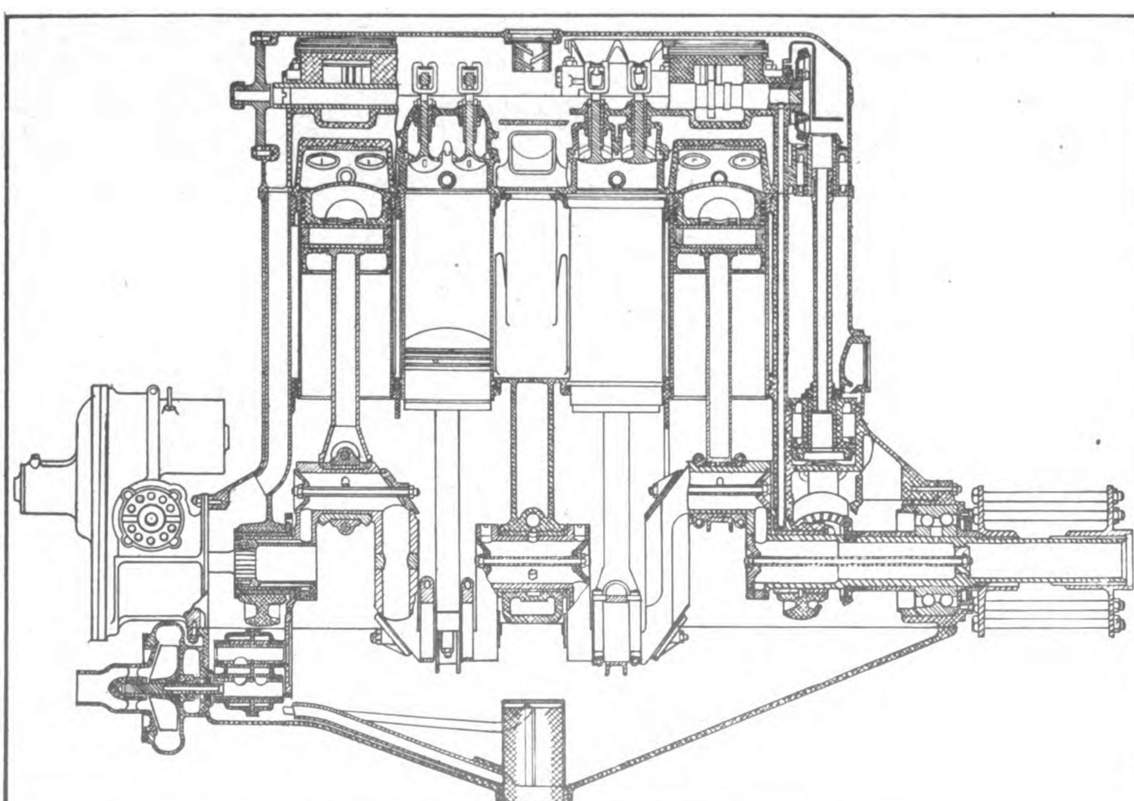


FIG. 5.—Longitudinal section.

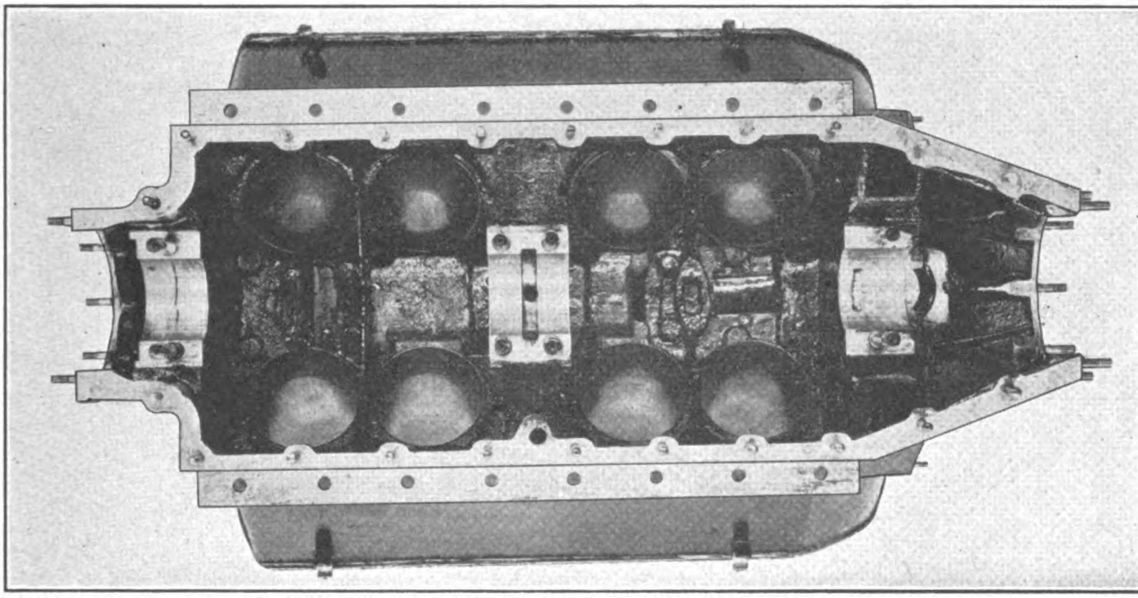


Fig. 6.—Crankcase, upper half, inside view.

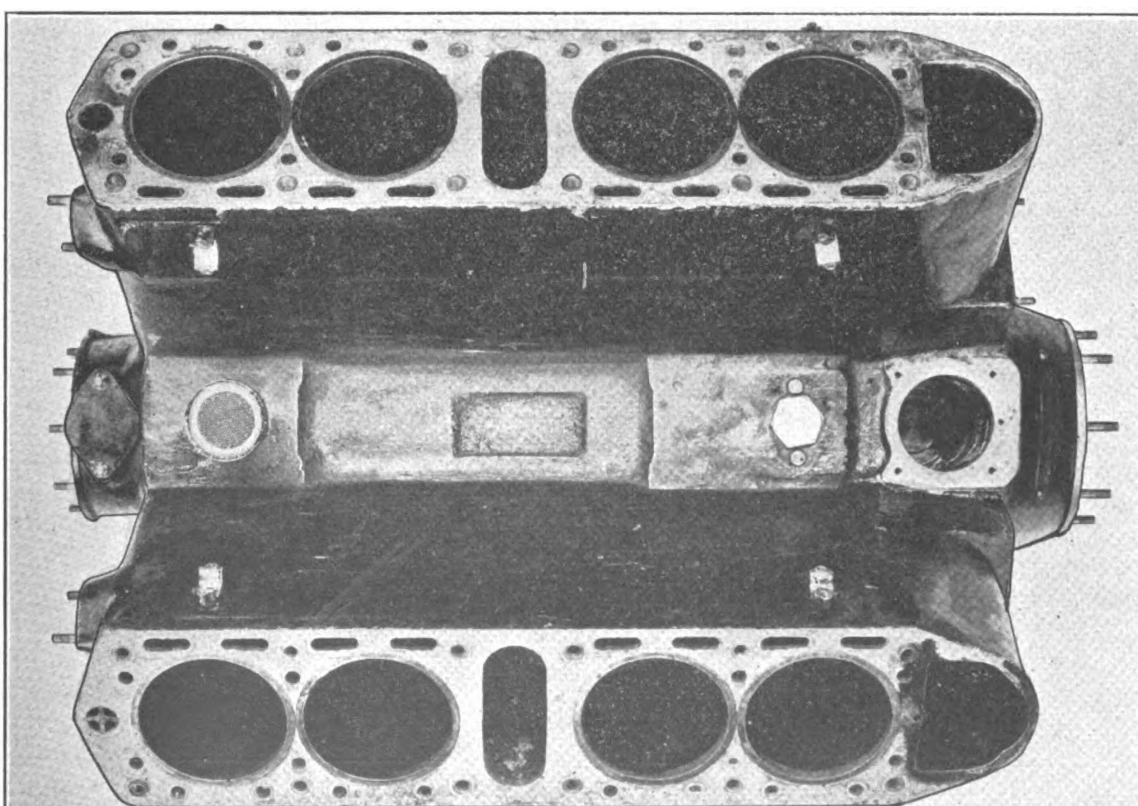


Fig. 7.—Crankcase, upper half, outside view.

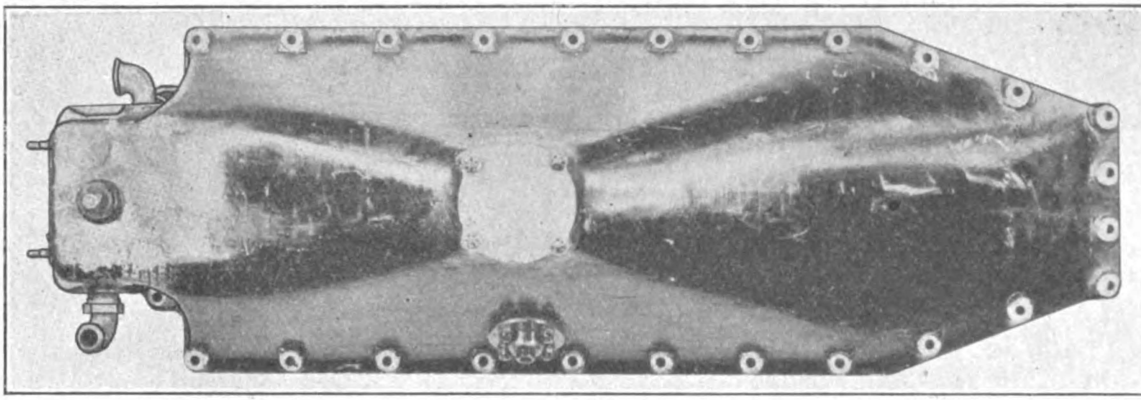


Fig. 8.—Crankcase, lower half, outside view.

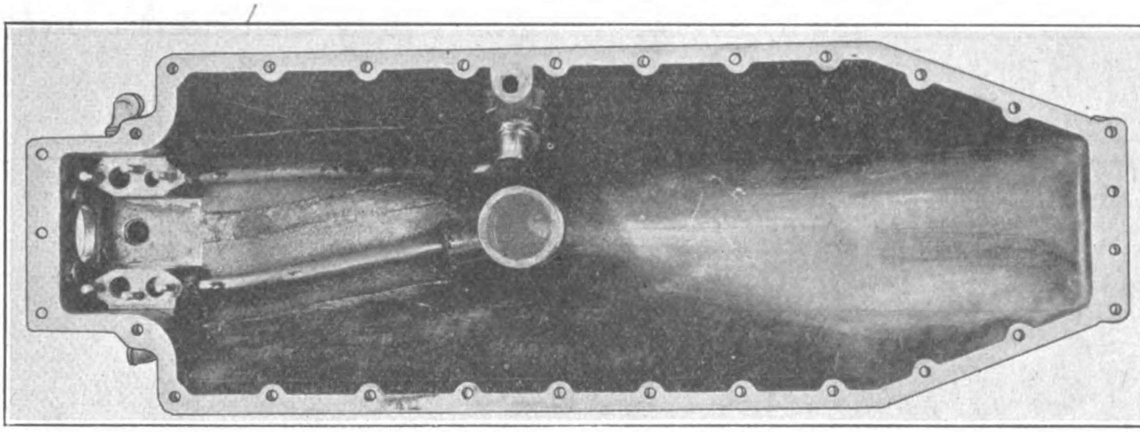


Fig. 9.—Crankcase, lower half, inside view.

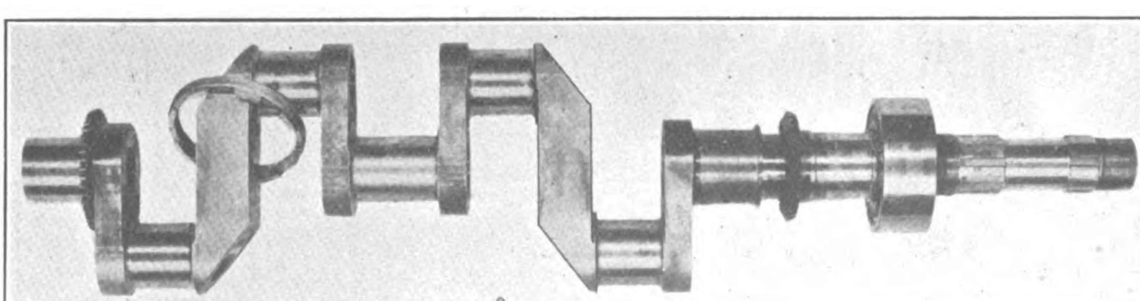


Fig. 10.—Crankshaft.

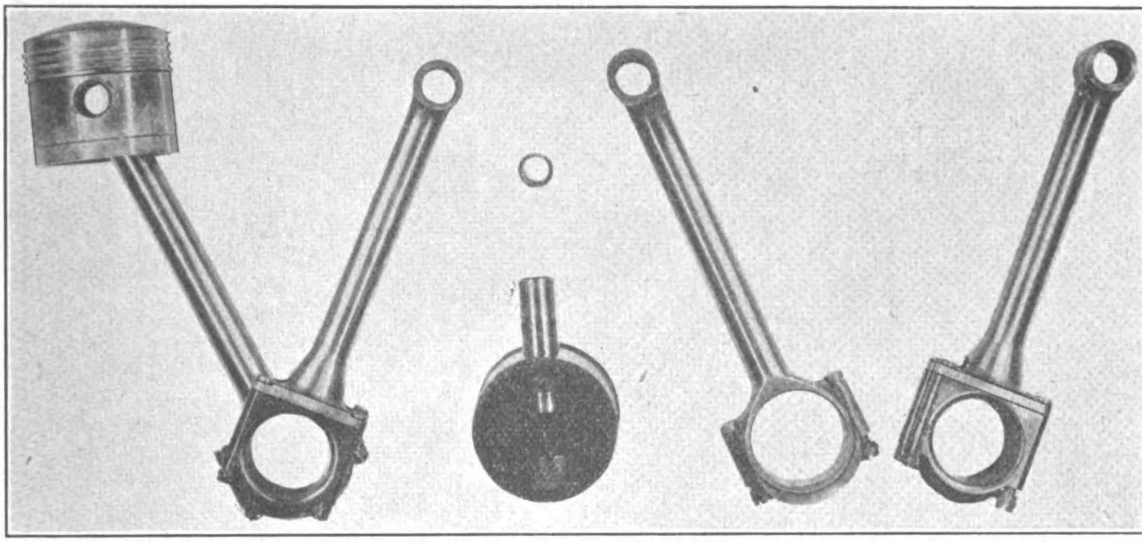


FIG. 11.—Piston and rods.

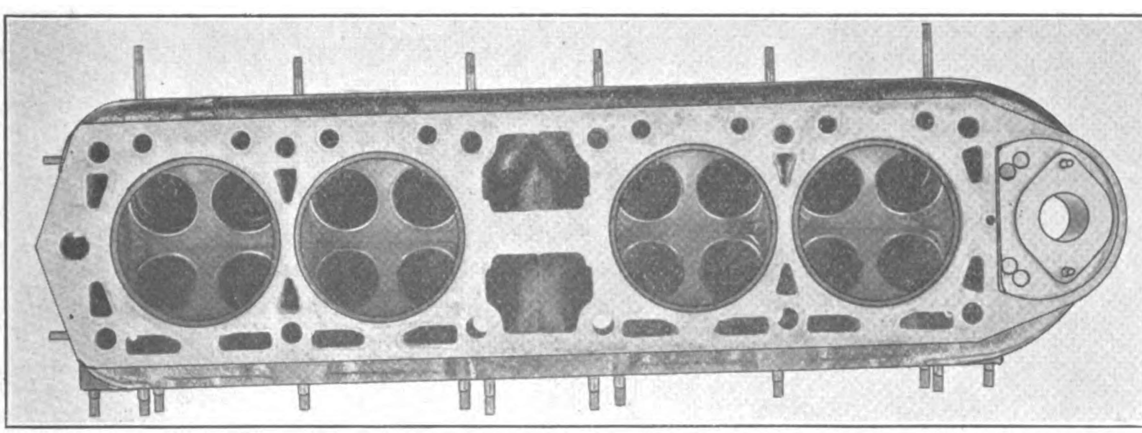


FIG. 12.—Lower view of cylinder head casting.

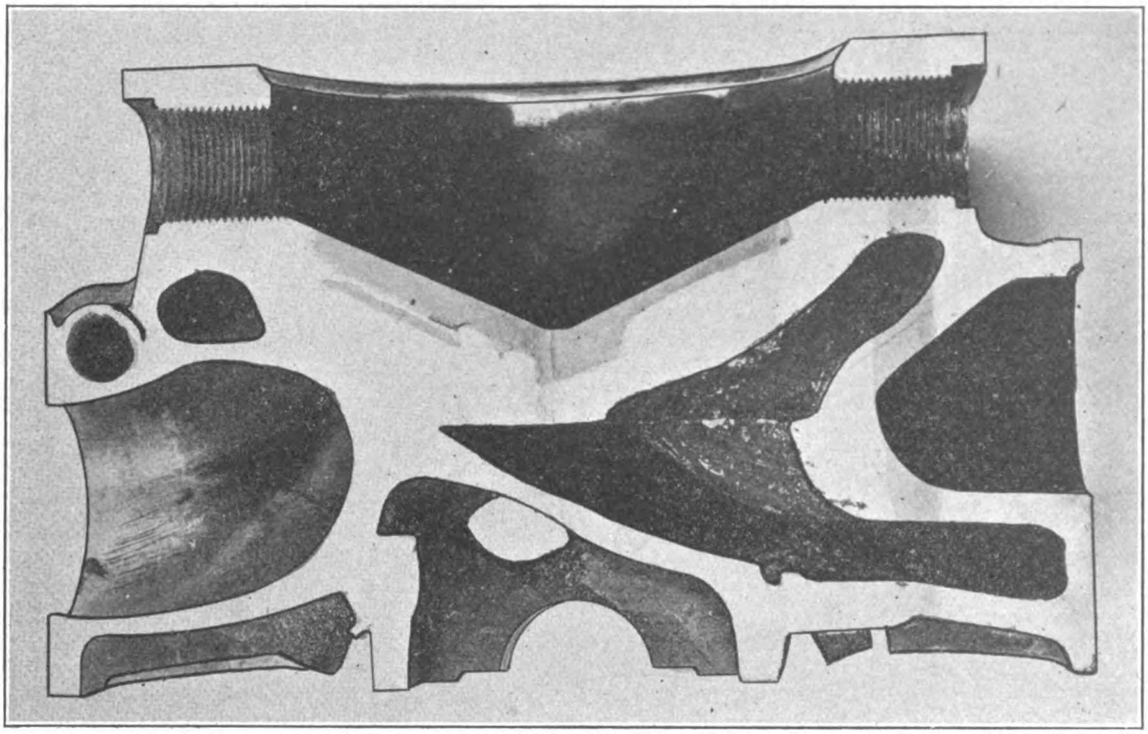


Fig. 13.—Sectional view of cast aluminum cylinder head.

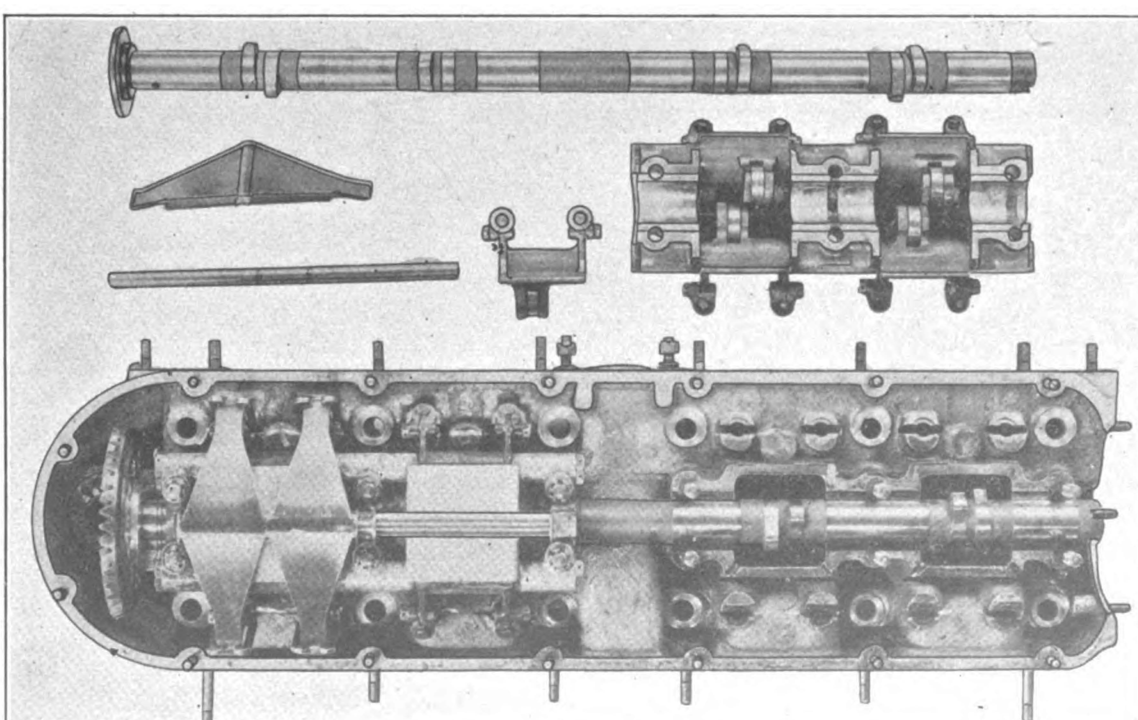


Fig. 14.—Cylinder head assembly with camshaft rockerarms and springs.

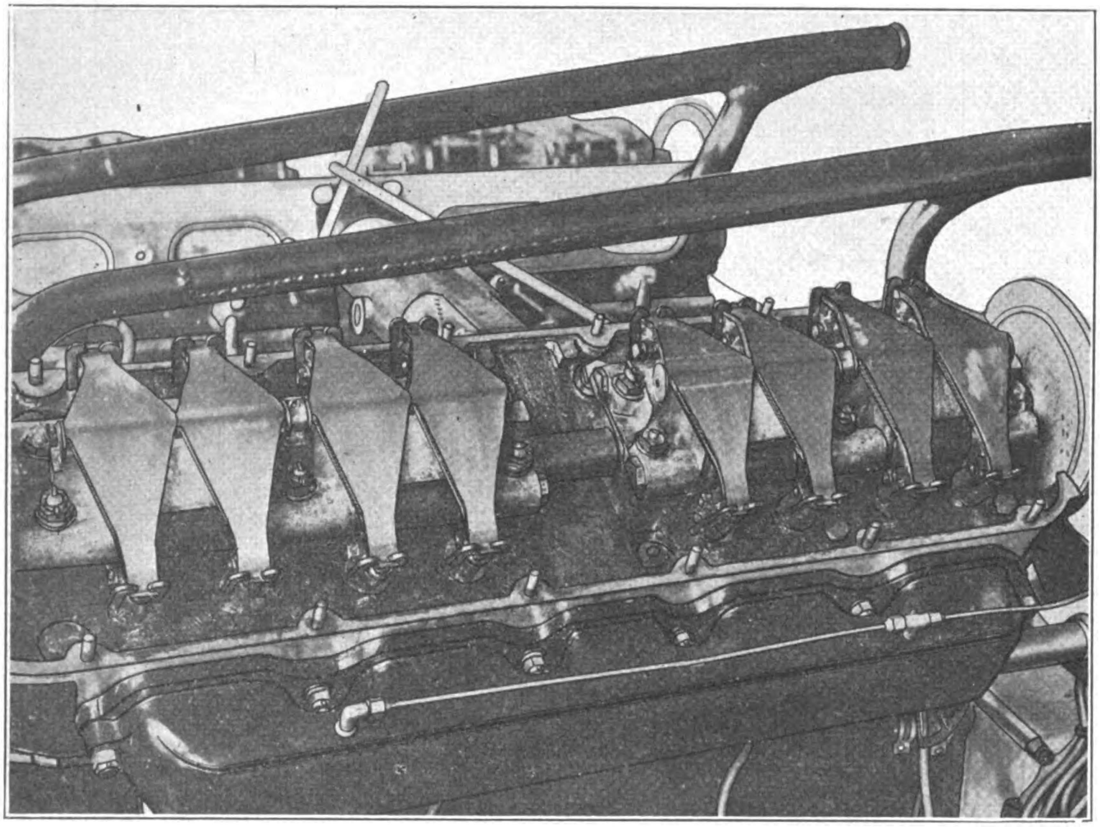


FIG. 15.—View of head ,with cover removed ,showing valve gear and flat springs.

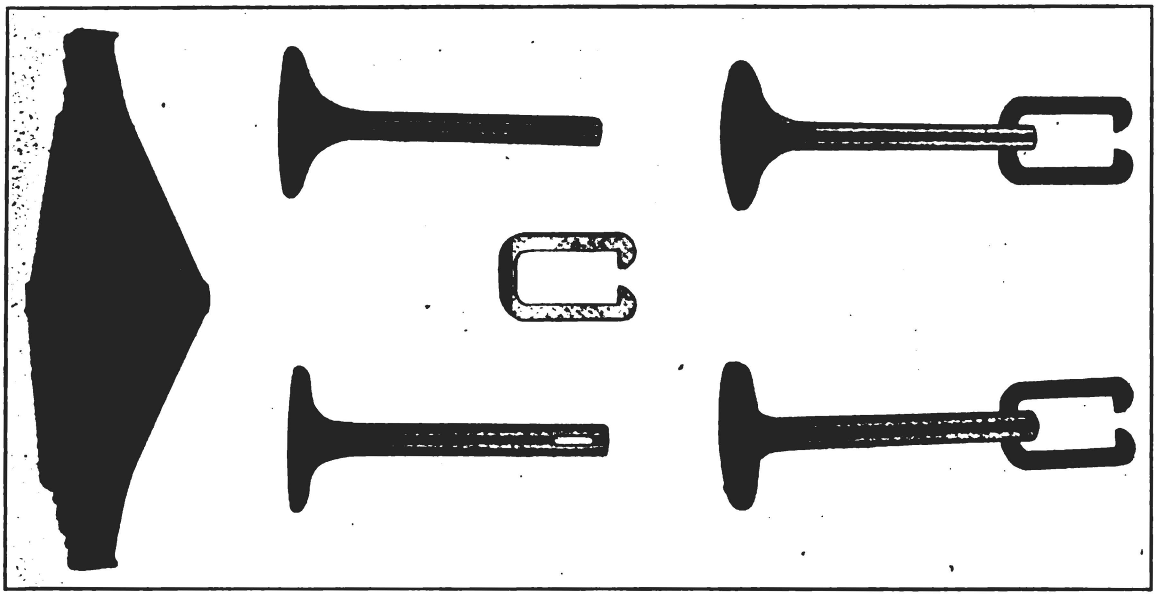


Fig. 16.—Valves and springs.

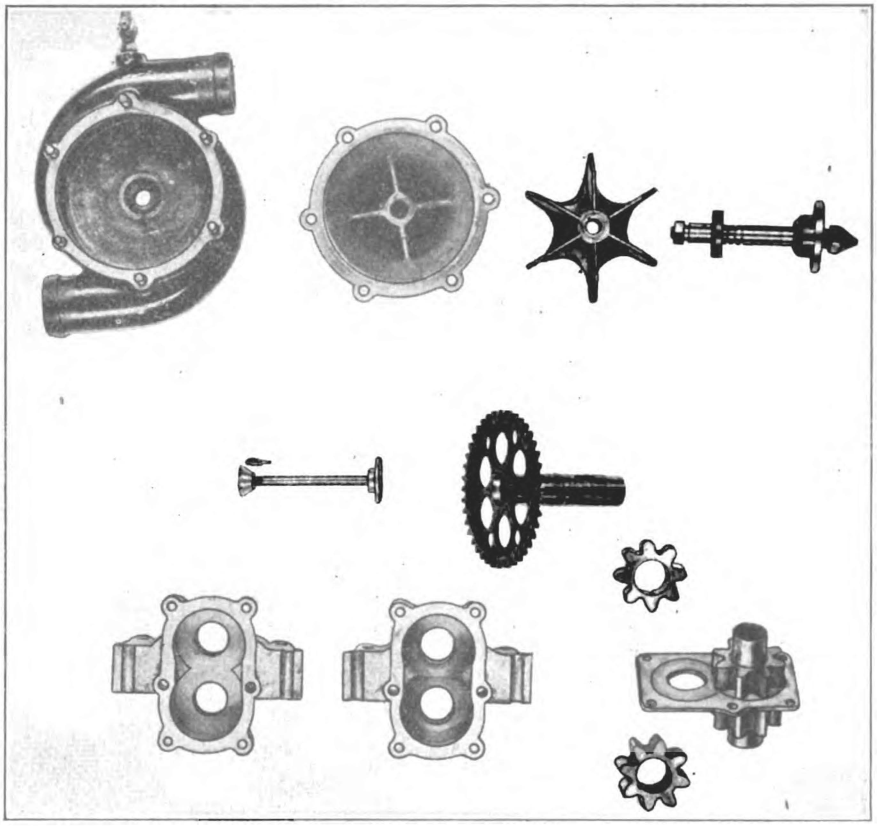


FIG. 17.—Water and oil pumps, disassembled.

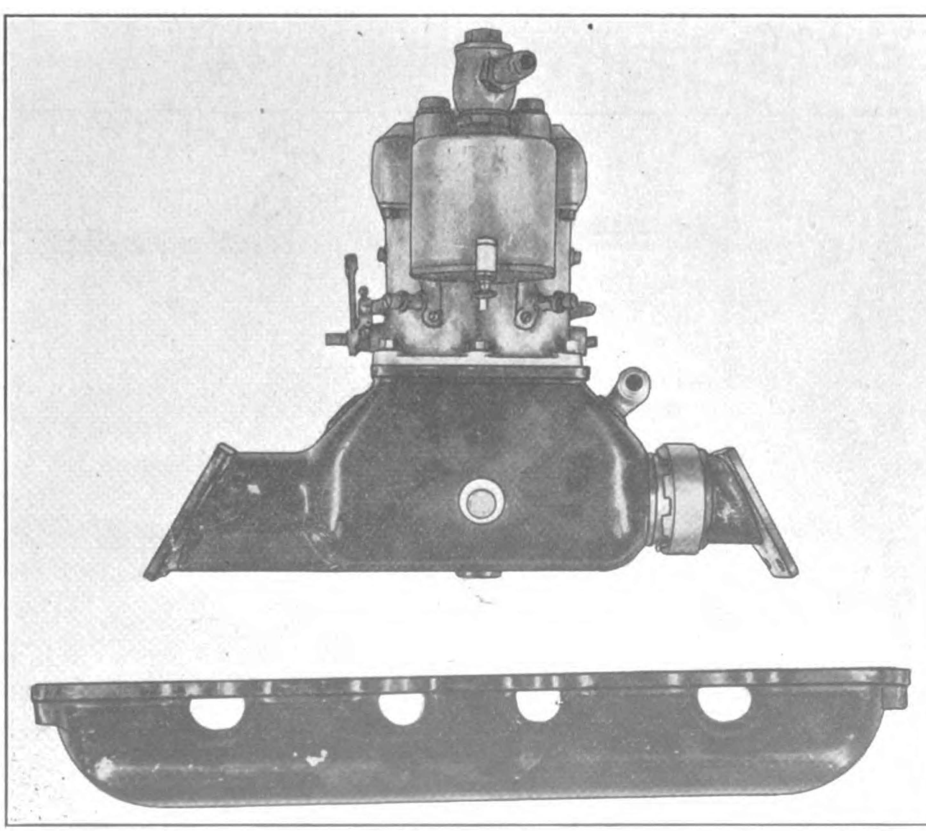


FIG. 18.—Carburetor and intake manifold.

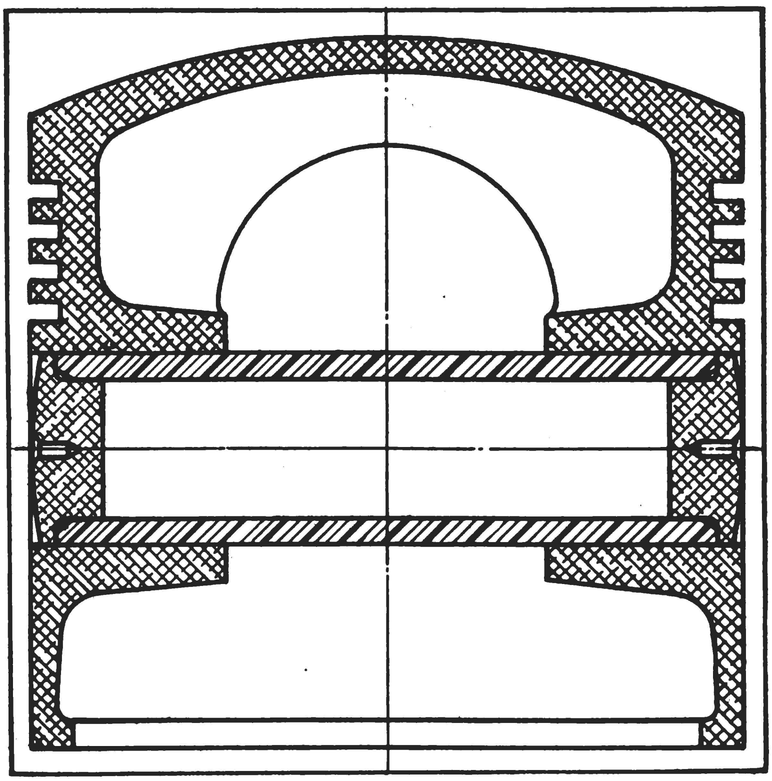


FIG. 19.—Sectional view of piston.

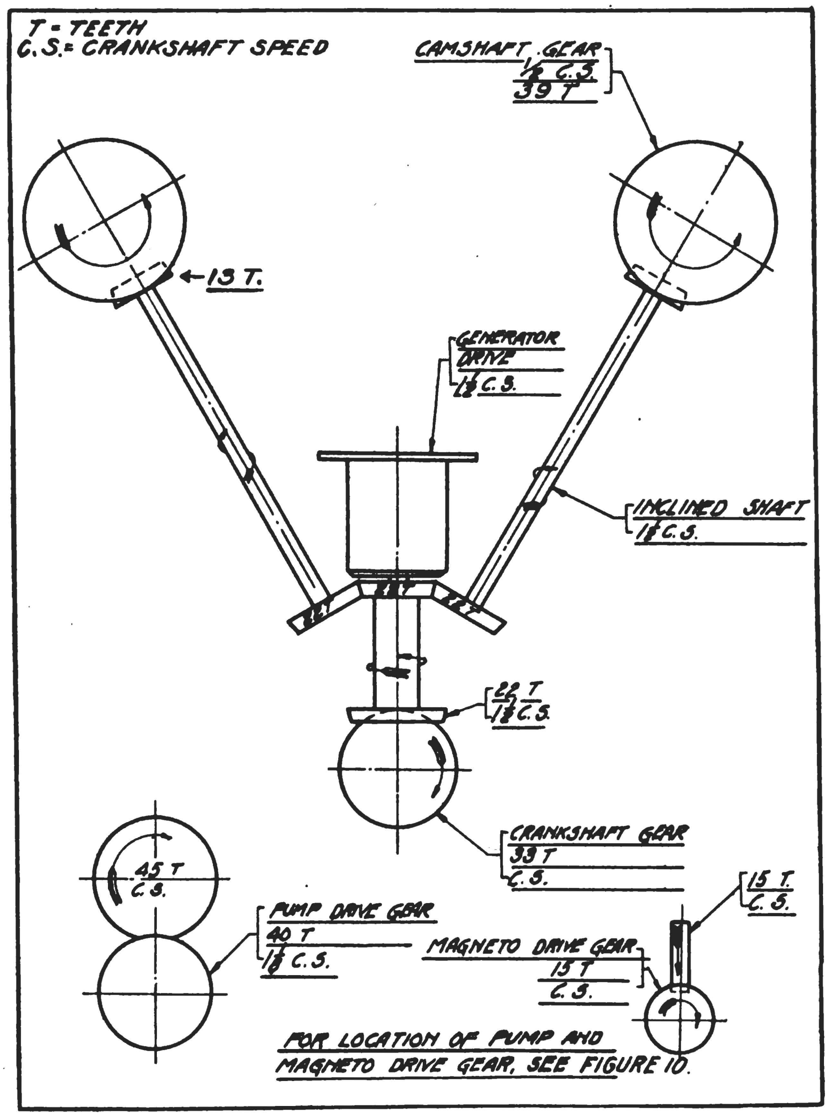


FIG. 20.—Diagram of accessory drive train.

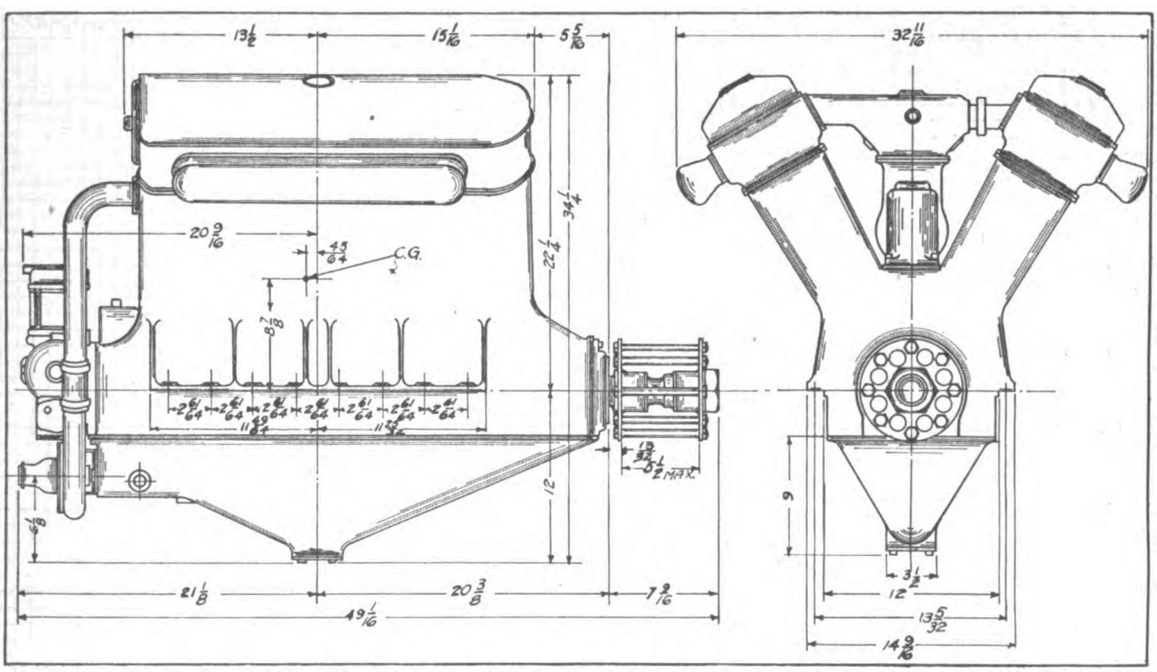


FIG. 21.—Installation diagram.

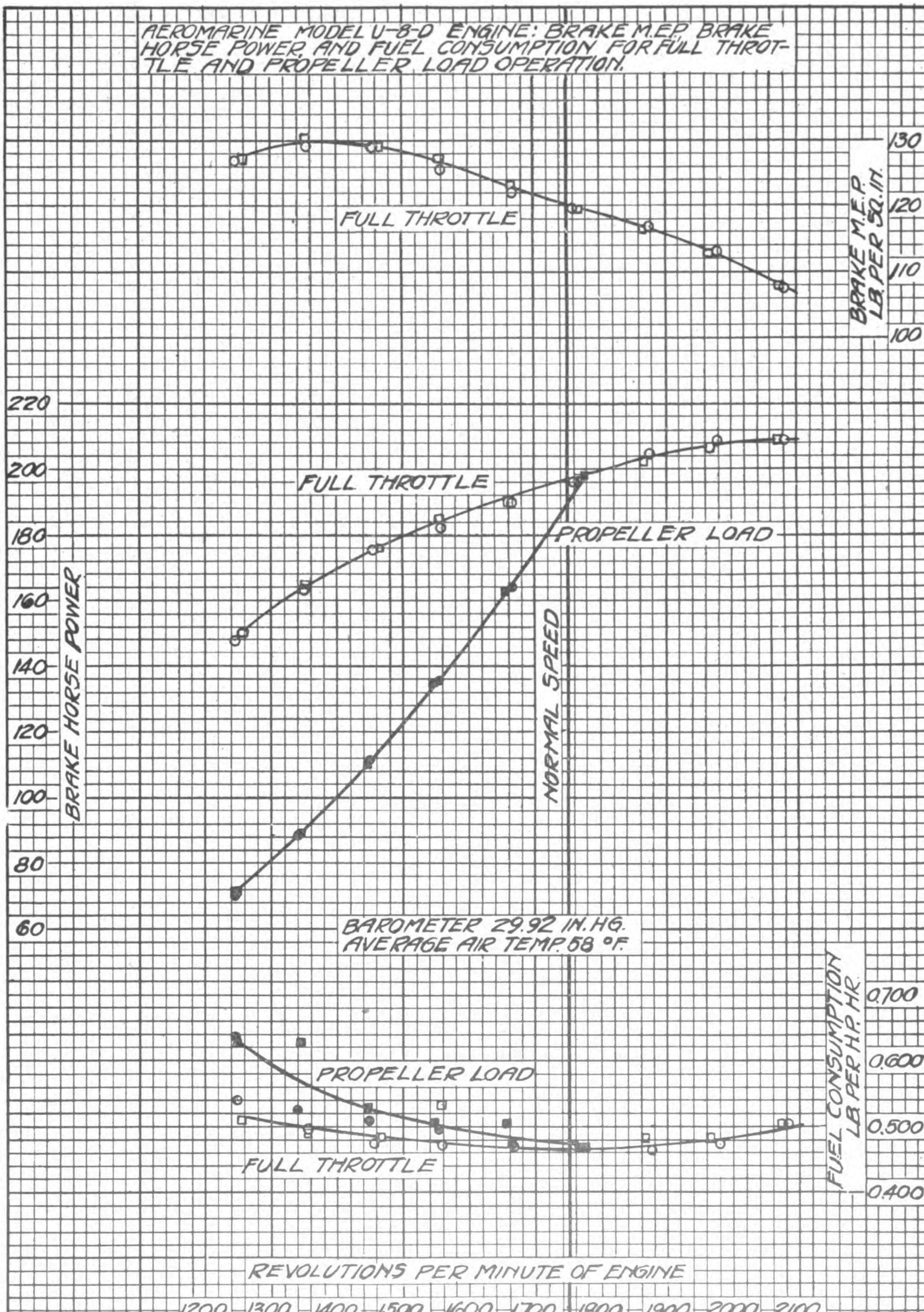
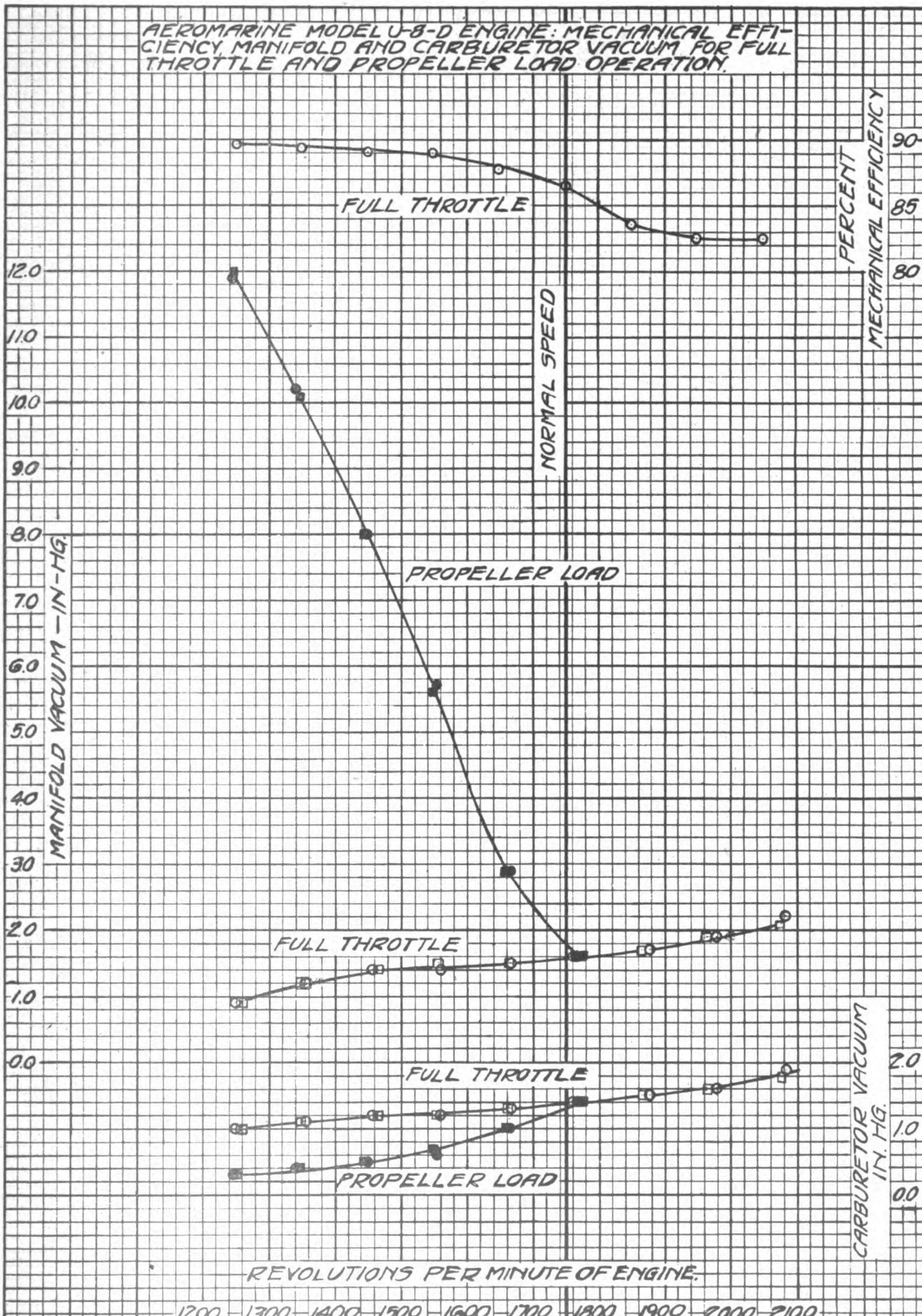

AEROMARINE MODEL U-8-D ENGINE: BRAKE M.E.P. BRAKE HORSE POWER AND FUEL CONSUMPTION FOR FULL THROTTLE AND PROPELLER LOAD OPERATION.
FULL THROTTLE
BRAKE M.E.P. LB. PER SQ. IN.
130
120
110
100
220
200
180
160
140
120
100
80
60
FULL THROTTLE
PROPELLER LOAD
BRAKE HORSE POWER
NORMAL SPEED
BAROMETER 29.92 IN. HG.
AVERAGE AIR TEMP. 58 °F.
FUEL CONSUMPTION LB. PER H.P. HR.
0.700
0.600
0.500
0.400
PROPELLER LOAD
FULL THROTTLE
REVOLUTIONS PER MINUTE OF ENGINE
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100

FIG. 22.



AEROMARINE MODEL U-8-D ENGINE: MECHANICAL EFFICIENCY, MANIFOLD AND CARBURETOR VACUUM FOR FULL THROTTLE AND PROPELLER LOAD OPERATION.
FULL THROTTLE
PERCENT MECHANICAL EFFICIENCY
90
85
80
NORMAL SPEED
PROPELLER LOAD
MANIFOLD VACUUM — IN-HG.
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
FULL THROTTLE
FULL THROTTLE
PROPELLER LOAD
CARBURETOR VACUUM IN. HG.
2.0
1.0
0.0
REVOLUTIONS PER MINUTE OF ENGINE.
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100

FIG. 23.

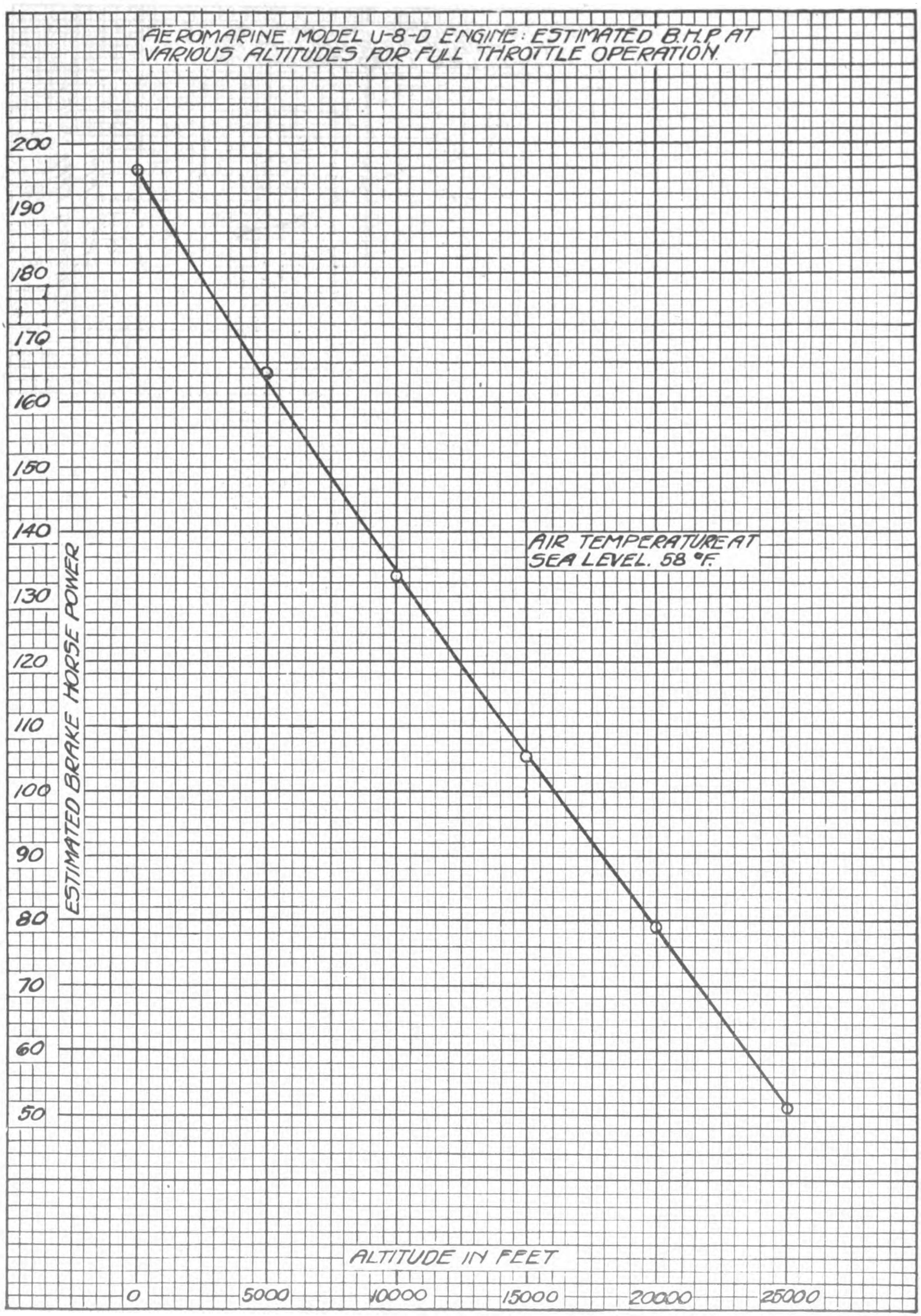

AEROMARINE MODEL U-8-D ENGINE: ESTIMATED B.H.P AT VARIOUS ALTITUDES FOR FULL THROTTLE OPERATION.
ESTIMATED BRAKE HORSE POWER
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
AIR TEMPERATURE AT SEA LEVEL. 58 °F.
ALTITUDE IN FEET
0
5000
10000
15000
20000
25000

FIG. 24.

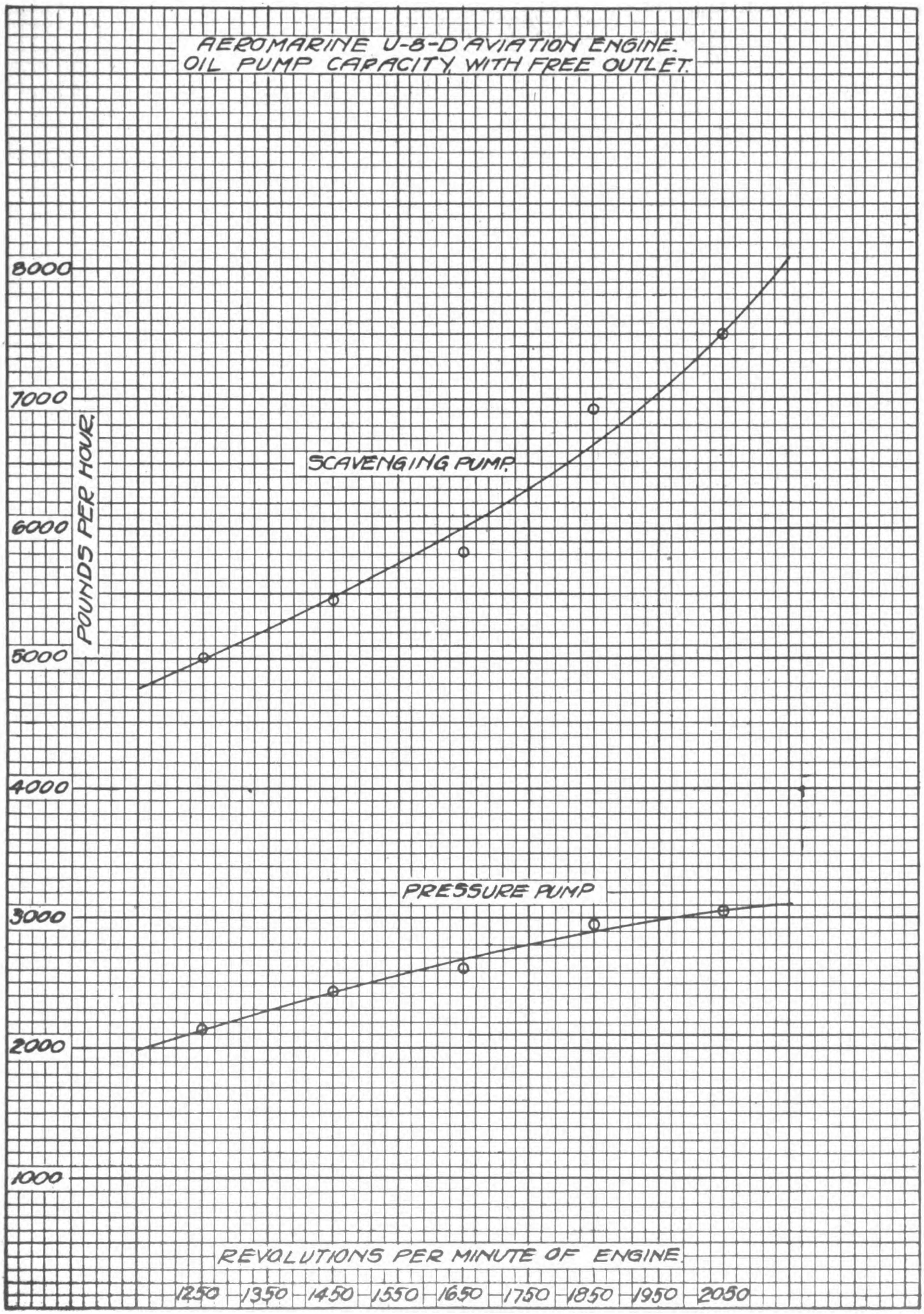

AEROMARINE U-8-D AVIATION ENGINE.
OIL PUMP CAPACITY, WITH FREE OUTLET.
POUNDS PER HOUR.
8000
7000
6000
5000
4000
3000
2000
1000
SCAVENGING PUMP.
PRESSURE PUMP
REVOLUTIONS PER MINUTE OF ENGINE.
1250
1350
1450
1550
1650
1750
1850
1950
2050

FIG. 25.

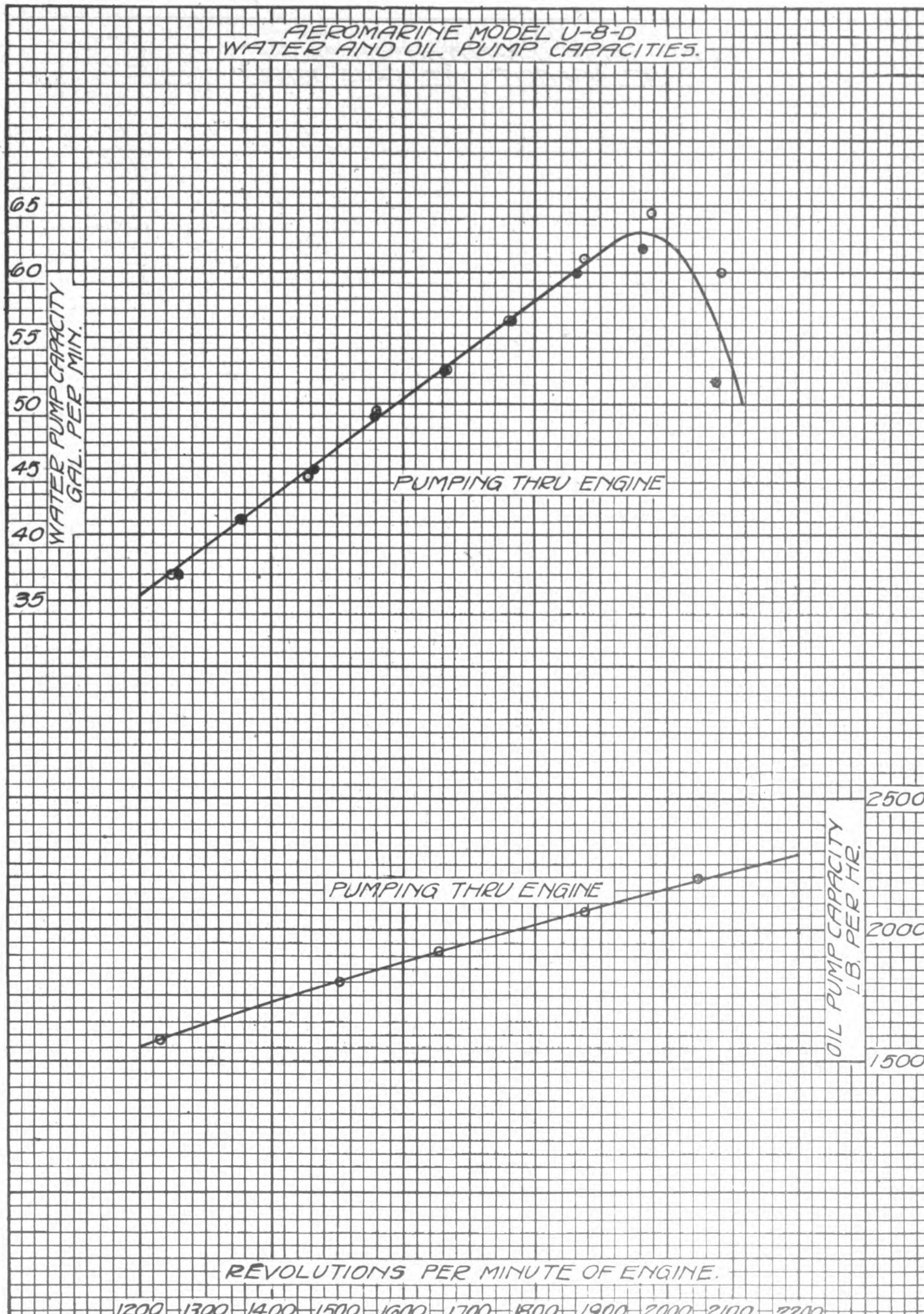

AEROMARINE MODEL U-8-D
WATER AND OIL PUMP CAPACITIES.
WATER PUMP CAPACITY
GAL. PER MIN.
65
60
55
50
45
40
35
PUMPING THRU ENGINE
PUMPING THRU ENGINE
OIL PUMP CAPACITY
LB. PER HR.
2500
2000
1500
REVOLUTIONS PER MINUTE OF ENGINE.
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200

FIG. 26.